MiSP Ecology/Pollution — Global Warming Worksheet #2, L3

Name _____ Date _____

Is There a Connection between Global Warming And Carbon Dioxide

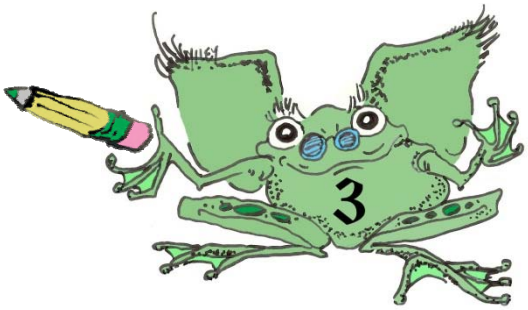
Introduction:

Greenhouse gases trap heat in our atmosphere. One of the greenhouse gases is carbon dioxide (CO_2). Carbon dioxide is a natural part of the atmosphere. It is produced by animals and plants when they break down food for energy and is used by plants when they make food. It is also added when we burn carbon-containing materials like wood, alcohol, and fossil fuels (coal, oil, and natural gas). Many people believe that increased amounts of CO_2 being added to the atmosphere due to the burning of fossil fuels are causing global warming.

In this exercise, we will look at temperature and carbon dioxide data from 1960 to 2005.

The most complete and accurate set of data on atmospheric CO_2 concentrations comes from the Mauna Loa Observatory on the island of Hawaii. Every hour for nearly half a century, scientists have collected air samples from above a barren lava field on the slopes of Earth's largest volcano. The remote location of this site minimizes local disturbances to measurements due to the activity of humans, other animals, and plants.

The temperature data comes from NASA and uses numbers from monitoring stations around the world.



Procedures:

- Use data from the charts and the graph below to show the changing CO_2 concentration and global average temperature over time.

Graph the data:

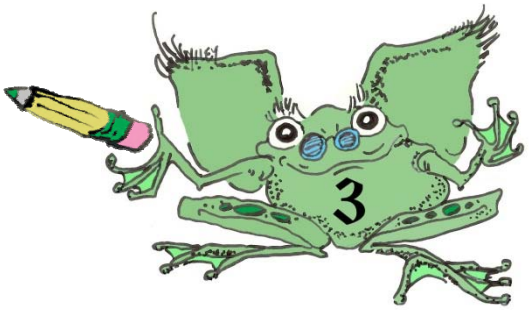
Temperature graph

- Label the *x*–axis.
- Label the *y*–axis.
- Connect the data points.
- Draw a best-fit line of the data.

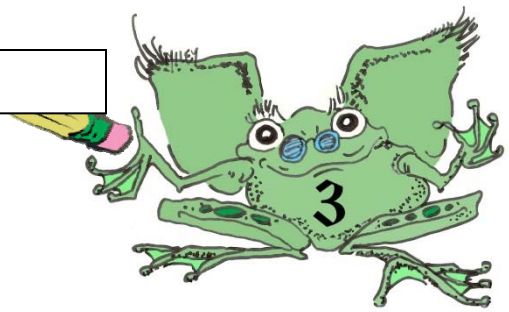
Carbon dioxide graph

- Label the *x*-axis.
- Label the *y*–axis.
- Connect the data points.
- Draw a best-fit line of the data.

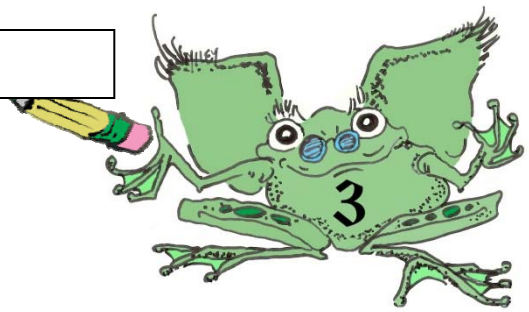
Year	Global Temperature (°C)	CO_2 Concentration (ppm)
1960	14.06	317
1965	13.91	320
1970	13.96	326
1975	14.00	331
1980	14.18	339
1985	14.22	346
1990	14.34	354
1995	14.33	361
2000	14.55	369
2005	14.68	380



Global Temperature from Meteorological Stations 1960-2005 (5 year running means)



Carbon Dioxide Concentrations from Mauna Loa Observatory, Hawaii, 1960-2005



Discussion Questions:

1. From 1960 to 2005, what has happened to:

   a. The average world temperature? _____

   _____

   b. Carbon dioxide concentration in the air? _____

   _____

2. The temperature data goes up and down from data point to data point. Does that mean that people cannot use the data to make predictions? Explain your answer.

   _____

   _____

   _____

3. Discuss how the two graphs compare. How are they similar? How are they different?

   _____

   _____

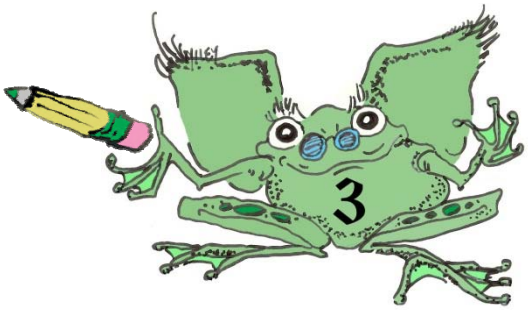
   _____

4. The two graphs DO NOT prove that changes in the carbon dioxide concentration in the air have caused global warming. Do the data tell us that changes in carbon dioxide are NOT the cause of global warming?

   _____

   _____

   _____



5. Scientists know that carbon dioxide is a greenhouse gas and therefore it traps heat in the atmosphere. So, why do people look at data like the two graphs that you made and propose that humans should reduce the amount of carbon dioxide they put in the air and do things to reduce the concentration of atmospheric CO_2?

_____

_____

_____

6. Using the best-fit lines on each of the two graphs, predict (extrapolate) the:

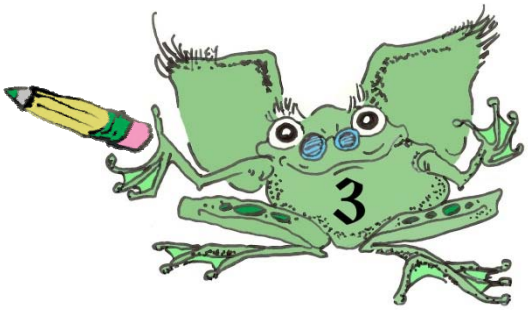
    a. average world temperature in 2015 _____

    b. concentration of carbon dioxide in 2015_____

7. Are the numbers you predicted in 6 greater or less than the temperature and carbon dioxide concentration data in 2005?

_____

_____



8. People can use unit rate of change (slope) to measure how fast a measurement such as carbon dioxide concentration or temperature is changing. Calculate the unit rate of change for the best-fit line on each graph. *(When you use a best-fit line, the ordered pairs to determine slope must be from the best-fit line, not from your data chart.)*

Unit Rate of Change — average world temperature = $\frac{\Delta \text{ temperature } (^{o}C)}{\Delta \text{ time (years)}} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ temperature (^{o}C) Δy	Δ Time (years) Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$

Unit Rate of Change in Carbon Dioxide Concentration =

$\frac{\Delta \text{ carbon dioxide (ppm)}}{\Delta \text{ time (years)}} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$

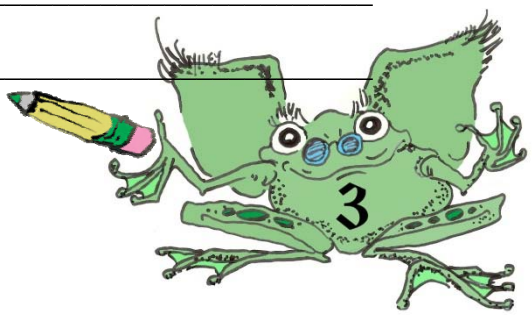
Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ carbon dioxide (ppm) Δy	Δ Time (years) Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$

9. Is the sign of these unit rates of change (slope) negative (-) or positive (+)? What does that mean about the changes in carbon dioxide concentration and temperature over time?

_____

_____

_____



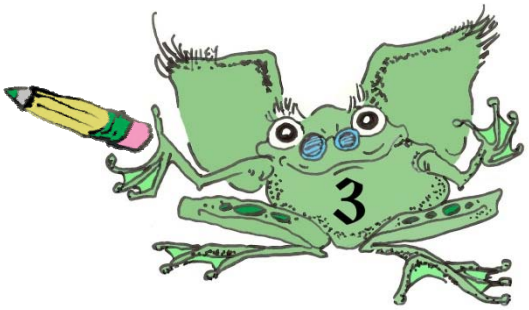
10. Use the unit rate of change (slope) of each graph's best-fit line (calculated in 5a) to determine how much carbon dioxide concentration and average world temperature will change in 10 and 50 years.

	10 years	50 years
average world temperature (°C)	_____	_____
carbon dioxide concentration (ppm)	_____	_____

11. There really is no year zero (0) but the recent increase in temperature began approximately in 1960 so we can consider 1960 year 0. Then 1965 is year 5, 1980 is year 20, and 2005 is year 45. (If you wish, you can write a second set of numbers on the *x*-axis of each graph. Therefore, the *y*-intercepts (when $x = 0$ {1960}) are when the best-fit lines cross 1960. Determine the *y*-intercept for each graph.

Ordered pair used to calculate slope for change in temperature (x_1, y_1) (x_2, y_2)	Ordered pair with adjusted *x*-values (x_1, y_1) (x_2, y_2) x = [year – 1960]
Ordered pair used to calculate slope for change in carbon dioxide level (x_1, y_1) (x_2, y_2)	Ordered pair with adjusted *x*-values (x_1, y_1) (x_2, y_2) x = [year – 1960]

Use the equation for a line to calculate the *y*-intercept. The equation for a line is
$y = mx + b$, where m is the unit rate of change (slope) and
b is the *y*-intercept

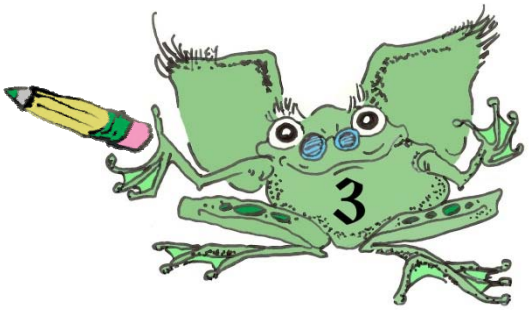


Y-Intercept for change in temperature
m =   Ordered pair (x, y) = (___ , ___) $y = mx + b$ Solve for b:

Y-Intercept for change in carbon dioxide
m =   Ordered pair (x, y) = (___ , ___) $y = mx + b$ Solve for b:

12. Based on the unit rate of change that you calculated above for each graph and the *y*-intercept, write an equation for each of the best-fit lines.

Equation — average temperature	Equation — carbon dioxide concentration



13. Use the formula you determined above to calculate average temperature and carbon dioxide in 2020 and 2050:

Year	Calculated average temperature (°C)	Calculated carbon dioxide concentration (ppm)
2020 (year 60 — use x = 60 in the equation)		
2050 (year 90 — use x = 90 in the equation)