

SPINOFFS

Spinoffs are relatively short learning modules inspired by the LTAs. They can be easily implemented to support student learning in courses ranging from prealgebra through calculus. The Spinoffs typically give students an opportunity to use mathematics in a real world context.

LTA - SPINOFF 20A

What's the Equation?

LTA - SPINOFF 20B

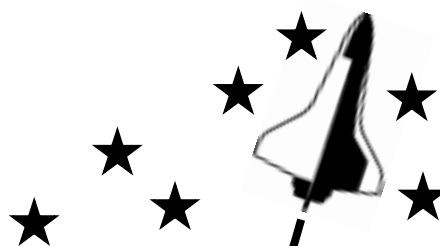
What's My Curve?

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SPINOFF 20A

What's the Equation?

The following table gives the concentrations of CO₂ in wheat plants grown in the Biomass Production Chamber. The measurements in parts per million (ppm) were made by Wheeler and Sager¹ over a period of 3 days. (The shaded values are the concentrations during the “Dark Cycles”, that is, the 4 hour periods when the lights were off.)

Time (in hrs)	CO₂ (ppm)	Time (in hrs)	CO₂ (ppm)	Time (in hrs)	CO₂ (ppm)
1	1040	25	1040	49	1030
2	1050	26	1040	50	1030
3	1040	27	1040	51	1030
4	1040	28	1040	52	1030
5	1040	29	1040	53	1030
6	1040	30	1040	54	1030
7	1040	31	1000	55	1040
8	1050	32	1040	56	1030
9	1180	33	1160	57	1160
10	1340	34	1320	58	1320
11	1500	35	1480	59	1480
12	1640	36	1620	60	1620
13	1520	37	1490	61	1500
14	1280	38	1260	62	1240
15	1100	39	1040	63	1040
16	1020	40	1030	64	1030
17	1020	41	1020	65	1030
18	1020	42	1020	66	1030
19	1050	43	1030	67	1040
20	1050	44	1030	68	1030
21	1050	45	1030	69	1040
22	1050	46	1030	70	1040
23	1050	47	1030	71	1040
24	1050	48	1030	72	1040

- 1) Use your calculator to make a scatterplot of the data.
- 2) Now, let's try to find a curve or graph that will “fit” this data.
 - a) Use your calculator to experiment with fitting different regression curves to the data. In each case, graph the curve on the coordinate system containing the scatterplot.

- b) What type of regression did you use? (Linear, Cubic, Quartic, Exponential, Logarithmic, etc.) Why did you pick the type that you did? What is “right” about the curve you found? Sketch the graph of this curve. What, if anything, is “wrong” with the curve you found.
- c) Can you think of a better function? You may want to try a piecewise function with a periodic bit. It may help to see if you can find a fit for the flat pieces first, and then search for a function that fits the “triangular spikes”.

Each of the “triangular spikes” in the data could be fitted with two line segments: an upward sloping segment that represents the increase in CO₂ concentration during the dark cycle and a downward sloping segment that represents the decrease in CO₂ concentration during the period immediately following the dark cycle. That is, the data suggest the pattern shown in Figure 1 below.

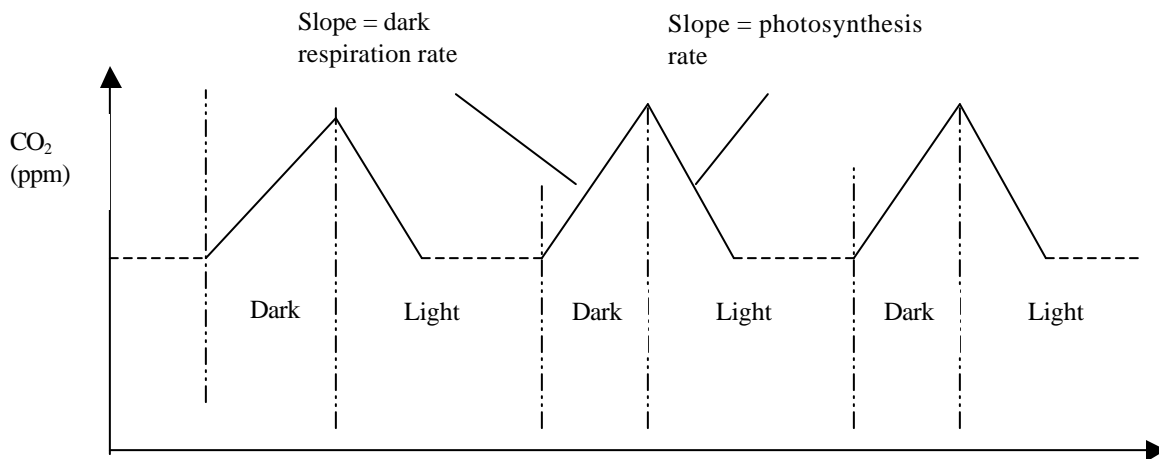


Figure 1

In Exercise 3, you will use the slopes of these line segments to estimate the dark respiration rate and the photosynthesis rate.

3. a) During the “Dark Cycles”, CO₂ in the chamber builds up due to plant respiration. These **increases** in concentration can be modeled using linear functions. Find three linear functions that describe the increase in CO₂ concentration during the dark cycles. What is your estimate of the dark respiration rate?
- b) Find three other linear functions that describe the **decrease** in CO₂ concentration in the periods immediately following the dark cycles when the plants are using the carbon dioxide for photosynthesis. What is your estimate of the photosynthesis rate?

1. Carbon Dioxide and Water Exchange Rates by a Wheat Crop in NASA’s Biomass Production Chamber: Results from an 86-Day Study (January to April 1989), by R. M. Wheeler and J. C. Sager, NASA Technical Memorandum TM 102788, January 1990.