Mathematics and Civic Engagement
SSI
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Materials at: http://tinyurl.com/or8946j

Name Institution

Course you teach which includes or might include issues of Civic Engagement:

What are some issues facing the nation and the world that you are concerned about?

Math and Solar Panels workspace:

The New Science of Learning

Three fundamental principals of learning that have both a solid research base to support them and strong implications for how we teach.

Key Findings	Implications for Teaching
1. Students come to the classroom with preconceptions about how the world works. New understandings are constructed on a foundation of existing understandings and experiences. If their initial understanding is not engaged, students may fail to grasp the new concepts and information that are taught, or they may learn for purposes of a test but revert back to their preconceptions outside the classroom.	1. Teachers must draw out and work with the preexisting understandings that their students bring with them including misconceptions.
2. To develop competence in an area of inquiry, students must (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.	2. Teachers must teach subject matter in depth, providing many examples in which the same concept is at work and providing a firm foundation of factual knowledge. Teachers should help students organize their knowledge into a coherent structure using key concepts.
3. A "metacognitive" approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them. '	3. The teaching of metacognitive skills should be integrated into the curriculum in a variety of subject areas.

From: Bransford, J., Brown, A., & Cocking, R. Editors. (2000). *How People Learn: Brain, Mind, Experience, and School.* Washington, D.C.: National Academy Press. Chapter One. Available on line at http://www.nap.edu/html/howpeople1/

Solar Panels, Energy and Area Under the Curve Lesson

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Goal: Determine the total energy produced by a solar panel array over the course of a day by using the graph of power vs time (see Figure 4).

Figure 1. Solar Panels.

1. What do you know about solar power?
2. Looking at the accompanying utilities bill for electric residential service, how much electricity was used during the current month? What units are used to describe the amount of electrical energy? How much was the electrical bill for the month?
3. What are the units for power and for energy and how are they related?
4. a. If a household is using 3 kW (kilowatt) of power continuously from 1pm to 5 pm (see Figure 2), how much energy is used?
   b. What is the area = height x width under the power curve for $1 \leq t \leq 5$? Give the units for this area that you get by multiplying the units for the height by the units for the width.

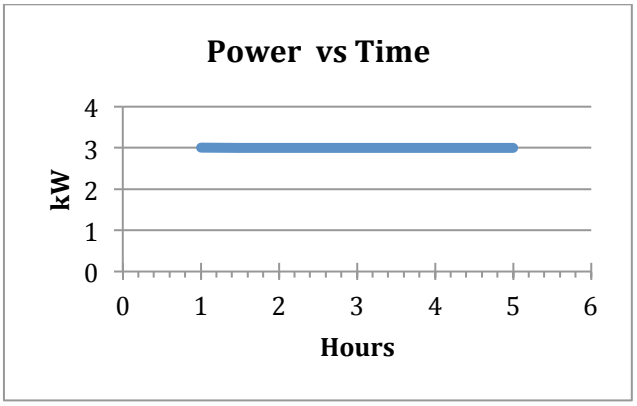

Figure 2. Energy usage with constant power.

5. a. If the household uses 2 kW of power from 1pm to 3pm, then 4 kW from 3pm to 7pm and 1 kW from 7 pm to 9 pm (see Figure 3), how much energy does it use?
   b. What is the area = height x width under the power curve for $1 \leq t \leq 9$? Give the units for this area that you get by multiplying the units for height by the units for the width.

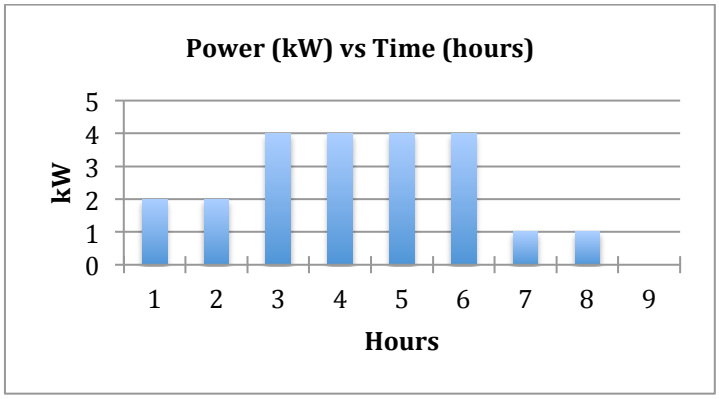

Figure 3a. Energy usage with piecewise constant power.

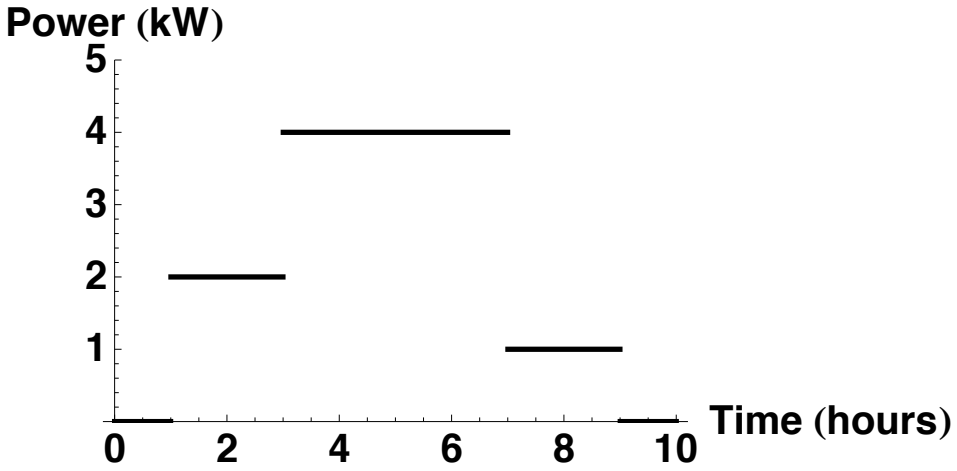

Figure 3b. Energy usage with piecewise constant power.

In Figure 4, we plot the power (kW) produced by a solar panel installation at Bryn Mawr College on January 27, 2013 as a function of time. The value of the power was recorded every 5 minutes so we have a plot of a discrete set of points rather than of a continous curve. We have plotted the data starting at 5 am and continuing until 7 pm (19 hundred hours).

6. At 9 am, how much power is being produced by the solar panels?
7. Estimate the time of sunrise and sunset on January 27, 2013 in Bryn Mawr, Pa.
8. The graph consists of values plotted at 5 minute intervals. On Figure 4, draw a continuous curve that fits the data.

9. Examine the power vs time graph generated by the solar panels (Figure 4).
   a. What is the maximum power that the solar panels generated during the day? At what time of day did that maximum occur?
   b. If the panels had been able to produce that maximum amount of power from sunup to sunset, how much energy would they have produced?
   c. Estimate how much energy the solar panels actually produced.
   d. Why are there some dips and wiggles in the graph?

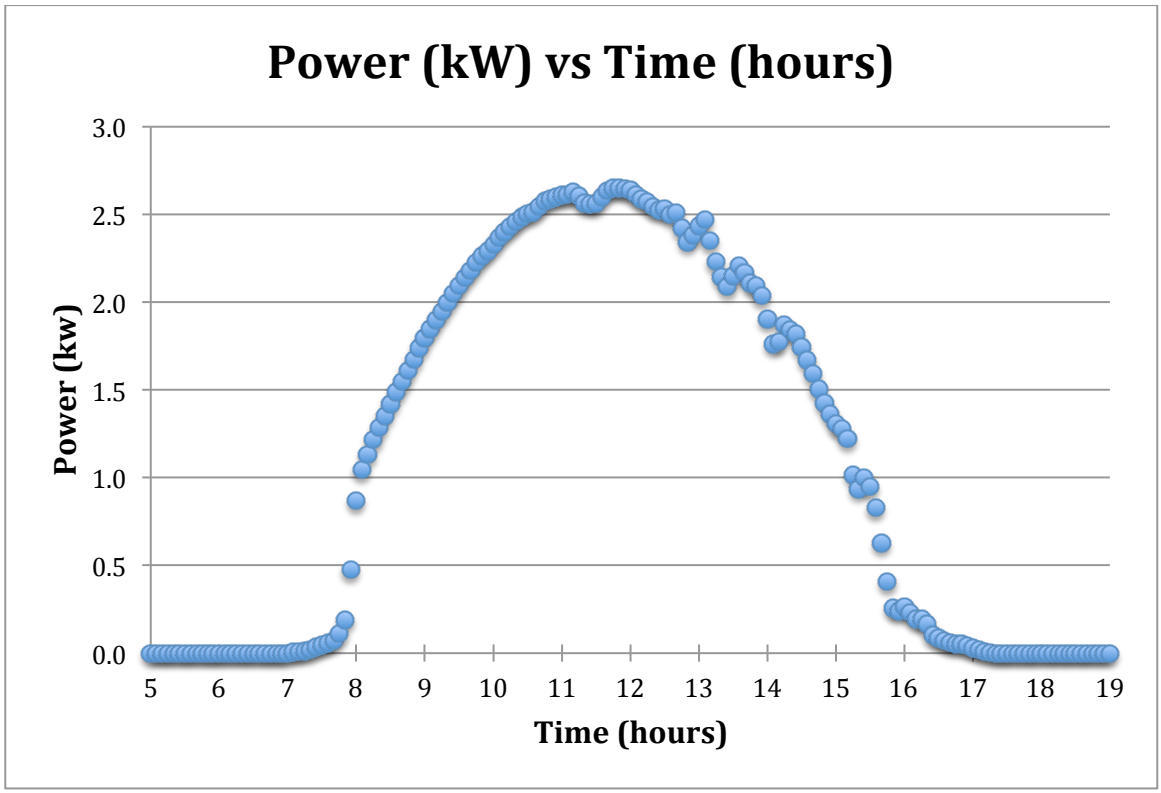

Figure 4. The power (kW) produced by a solar panel installation at Bryn Mawr College on January 27, 2013. http://sustainability.blogs.brynmawr.edu/2012/11/13/first-solar-panels/.

10. Do you think it would be "worth it" home to install solar panels at your school (or home)? What information would you need to be able to answer this question? Present your findings to the school board (or college administration).

Meter Information

Read Date	Meter Number	Load Type	Reading Type	Meter Reading Previous	Meter Reading Present	Difference	Multiplier X	Usage
02/06	016462079	General Service	Total Ccf	6201 Actual	6432 Actual	231	1	231
02/06	065518976	General Service	Tot kWh	69268 Actual	70447 Actual	1179	1	1179

Total Ccf Used 231
Total kWh Used 1,179

Gas Residential Heating Service - Current Period Detail — Service 01/05/2012 to 02/06/2012 - 32 days

Customer charge				$11.75
Natural Gas Supply Charges	231 Ccf	X	$0.58312	134.70
Distribution Charges	231 Ccf	X	0.37606	86.87
Balancing Service Charges	231 Ccf	X	0.03434	7.93
Gas Cost Adjustment Charges	231 Ccf	X	0.01167	2.70
State Tax Adjustment				-0.24
Total Current Charges				**$243.71**

13-Month Usage (Total Ccf)

Your Usage Profile

Period	Usage	Avg Daily Usage	Days	Avg Daily Temp
Current Month	**231**	**7.2**	**32**	**39**
Last Month	227	7.0	32	42
Last Year	372	11.6	32	29

Avg Ccf per Month	106
Total Annual Ccf Usage	1,279

Electric Residential Service - Current Period Detail — Service 01/05/2012 to 02/06/2012 - 32 days

Customer charge				$7.20
Generation Charges	1,179 kWh	X	$0.09180	108.23
Transmission Charges	1,179 kWh	X	0.00740	8.72
Wind Energy Service Charge	300 kWh	X	0.02540	7.62
Distribution Charges	1,179 kWh	X	0.06000	70.74
State Tax Adjustment				-0.04
Total Current Charges				**$202.47**

13-Month Usage (Total kWh)

Your Usage Profile

Period	Usage	Avg Daily Usage	Days	Avg Daily Temp
Current Month	**1,179**	**36.8**	**32**	**39**
Last Month	1,519	47.4	32	42
Last Year	1,332	41.6	32	29

Avg kWh per Month	1,442
Total Annual kWh Usage	17,305

DO NOT MAIL THIS PORTION WITH YOUR PAYMENT