Institute for Sustainable Energy
at Eastern Connecticut State University

ENERGY DAY CURRICULUM IDEAS-MATH

Topic	Elementary	Middle School	High School
M1 What's the wattage?	**X**	**X**	**X**
M2 Compare and Save	**X**	**X**	**X**
M3 Weigh to Go!	**X**	**X**	
M4 Exit Here	**X**	**X**	**X**
M5 Energize Connecticut		**X**	**X**
M6 Paper or Plastic?		**X**	**X**
M7 Figure It Out		**X**	**X**
M8 Reading Into Savings and Lights Out!		**X**	**X**

M1 What's the Wattage?

Elementary Calculate the wattage of lights in your classroom.

Find the wattage of the lamps in you classroom and count the lamps. Calculate the amount of electricity used and its cost. Determine the kWh savings from turning them off when they are not needed.
Provide students with a worksheet to create a data table. Discuss how to find the wattage listing on light bulbs. Offer sample fixtures and bulbs for examination. Ask the facilities manager or custodian to assist students in their investigation.
Have students work in teams to compile their data.
Lead a class discussion about the findings. How can this information be used?

A short lesson plan about calculating kilowatt hours used by a compact fluorescent light bulb. Grades 4-6:
http://www.betterwaytosave.com/bwts/downloads/Math%20Mania.pdf

Energy UUUU and Watt Watchers programs are available through Wilson Educational Services, Inc. For more information see http://www.wilsoned.com/Programs.html

Middle School/High School Taking the information to the next level.

In the class discussion, have students create a directed inquiry. Allow teams to work together to propose an investigation and to develop a plan to complete the investigation. One such plan might be to create a school wide scavenger hunt to calculate lighting-related energy use in the school.

Bright Ideas and STEM, Savings Through Energy Management programs are available through Wilson Educational Services, Inc. For more information see
http://www.wilsoned.com/Programs.html

ENERGY DAY CURRICULUM IDEAS-MATH

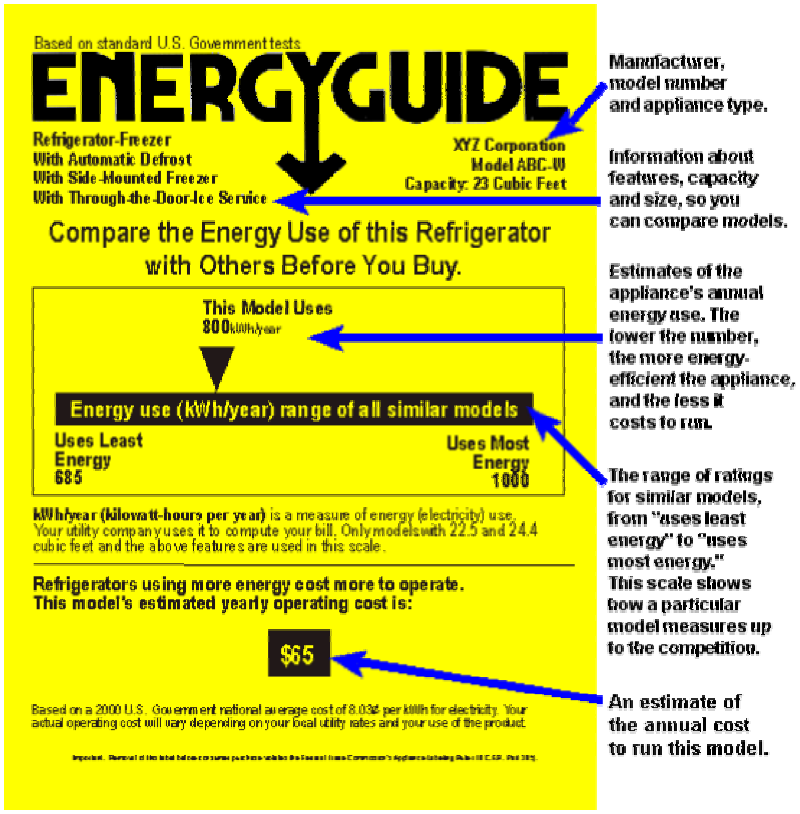
M2 Compare and Save

Elementary Discuss and compare the energy used to do everyday tasks.

Have students brainstorm ways that energy is used in the school or at home. Have students build a chart to compare a high energy use with its companion low energy use: i.e. compare the energy needed to operate an appliance with it alternative, i.e. and air conditioner vs a fan, a clothes dryer vs a solar clothes dryer.
Discuss how we can decide to conserve energy with our choices about how we live.

Upper Elementary/Middle School/High School Taking the information to the next level.

Check out the energy use label for several appliances.
Provide students with copies of several tags from different appliances. These can be obtained from appliance stores. Compare the information and discuss how to calculate to compare two appliances' actual cost. Discuss the expected lifetime of the different appliances and calculate the life cost of each appliance.
Have students create graphs or charts that compare the cost of two appliances.



ENERGY DAY CURRICULUM IDEAS-MATH

M3 Weigh to Go!

Elementary/Middle School Calculating the weight of trash that the classroom produces.

Discuss the sources of trash produced in school by the classroom.
Weigh the garbage that your class produces during the day. Consider paper and food wastes.
Calculate the weight of garbage/trash in each category. Discuss how to estimate the amounts created by larger populations, such as the whole grade, or whole school.
Discuss ways to reduce, reuse and recycle your trash.
Brainstorm ideas that will reduce waste in the classroom. Discuss how can your class promote your ideas in the class or for the whole school.

M4 Exit Here

All Investigating the energy used by exit lights.

Exit lights are a significant user of energy in school buildings.
Ask the school custodian or facility manager to assist the class in their investigation. Ask the custodian if the lights remain on at all hours or are they on timers? Discuss with the class why exit lights are used and building code requirements.
With the assistance of the custodian, open and examine the different types of exit lights used in the school. Have the custodian assist the class in finding the bulb type and wattage.
Break the class up into competitive groups and have each team list the number and location of all of the lights in the school. Have teams present their counts before going out in the school.
Create a scavenger hunt paper and have the teams do an inspection and listing of the actual locations and numbers. On returning to the class room, have teams complete calculation of the wattage used by the lights.
Calculate the cost to operate the EXIT signs in your school for an entire year. Investigate alternatives and the building code rules about signs.

http://yosemite.epa.gov/estar/consumers.nsf/content/exitsigns.htm#exit

http://www.epa.gov/nrgystar/purchasing/calculators/exit-main.html

M5 Energize Connecticut

Middle School/High School Investigate energy use in Connecticut.

Discuss with the class how the energy used in Connecticut is made and the sources of the power. Discuss how energy use has changed over time.

ENERGY DAY CURRICULUM IDEAS-MATH

Graph the types and totals of energy sources. Estimate and project how you think energy use will change in the next 5-10 years. Compare your information with past growth trends.

Resources: CT Energy on the Institute for Sustainable Energy's web site, and EIA info links

http://www.eia.doe.gov/emeu/states/main_ct.html

M6 Paper or Plastic?

Upper Elementary/Middle School/High School Compare the costs of using paper vs plastic shopping bags.

Plastic and paper used in shopping bags are significant uses of resources, power, and in the case of plastics, petroleum products.
Estimate the number of bags used in a local market and calculate the costs if one kind, or the other were used. Ask the retailer about the cost of each kind of bag.

Are there recycling programs in your town for plastic bags? Is the local market a participant in collection for recycling? How can your class improve the recycling of plastic bags?
Efforts might include:
Advocating to the town to start plastic recycling program
Starting a bag recycling program at the store
Promoting an existing program with posters or other promotion

Resources, Bombay India campaign info:
News article http://news.bbc.co.uk/1/hi/world/south_asia/1329600.stm
http://www.expressindia.com/ie/daily/19990122/02250565p.html
http://news.bbc.co.uk/1/hi/uk/1969997.stm
http://www.mindfully.org/Plastic/Polyethylene/Bags-Choking-India22oct00.htm
http://www.indbazaar.com/consumerguide/index2.asp?ct=17

M7 Figure It Out

Middle School/High School Evaluate and compare mileage statistics for different car models.

Investigate the statistics for several types of cars, a SUV, a compact, a hybrid, a minivan, and a sports car.
Data might include:
Calculations and charts of costs, MPG, Graphs of gas use and cost in a year, features of the compared vehicles

ENERGY DAY CURRICULUM IDEAS-MATH

Groups might debate the relative purchase of various vehicles.
Present a poster or power point exhibit with your findings.
Resources:
Car Fact sheet included at the end of this packet
http://www.epa.gov/autoemissions/cars-rank-03.htm
www.fueleconomy.gov

High School Caluculus CALCULUS LAB: DETERMINING ENERGY NEEDS
NUMERICAL APPROXIMATION, INTEGRATION & DEGREE-DAYS

(Submitted by Steve Lecky, Middetown High School (leckys@mps1.org):

This is a newly created lab activity designed for Calculus students with two goals in mind: to provide an energy application for the use of estimating areas using a trapezoidal approximation and for the use of a definite integral. I'll be experimenting with the lab on or near to the March 21st Energy Day event.)

A degree-day is a quantitative index that reflects demand for energy to heat homes and businesses. For any day that has an average temperature below 65 degrees Fahrenheit, the assumption is that some heating of the home or business will be needed. By definition, one degree-day would represent that for a given day, the average temperature for the day was one-degree below 65. To better understand the degree-day calculation, consider the following table:

Day	Average Temperature	# of degree-days
Monday	55	65-55=10
Tuesday	53	65-53=12
Wednesday	49	65-49=16
Thursday	45	65-45=20
Friday	60	65-60=5

Notice that on the coldest days, the higher energy demand is reflected by the larger number of degree-days. For the five days, the total number of degree-days is 63.

Our goal is to determine the number of degree-days for a typical January and then to estimate energy costs. Depending on the number of degree-days, oil companies can pretty accurately determine how long they can wait between deliveries of oil to homes.

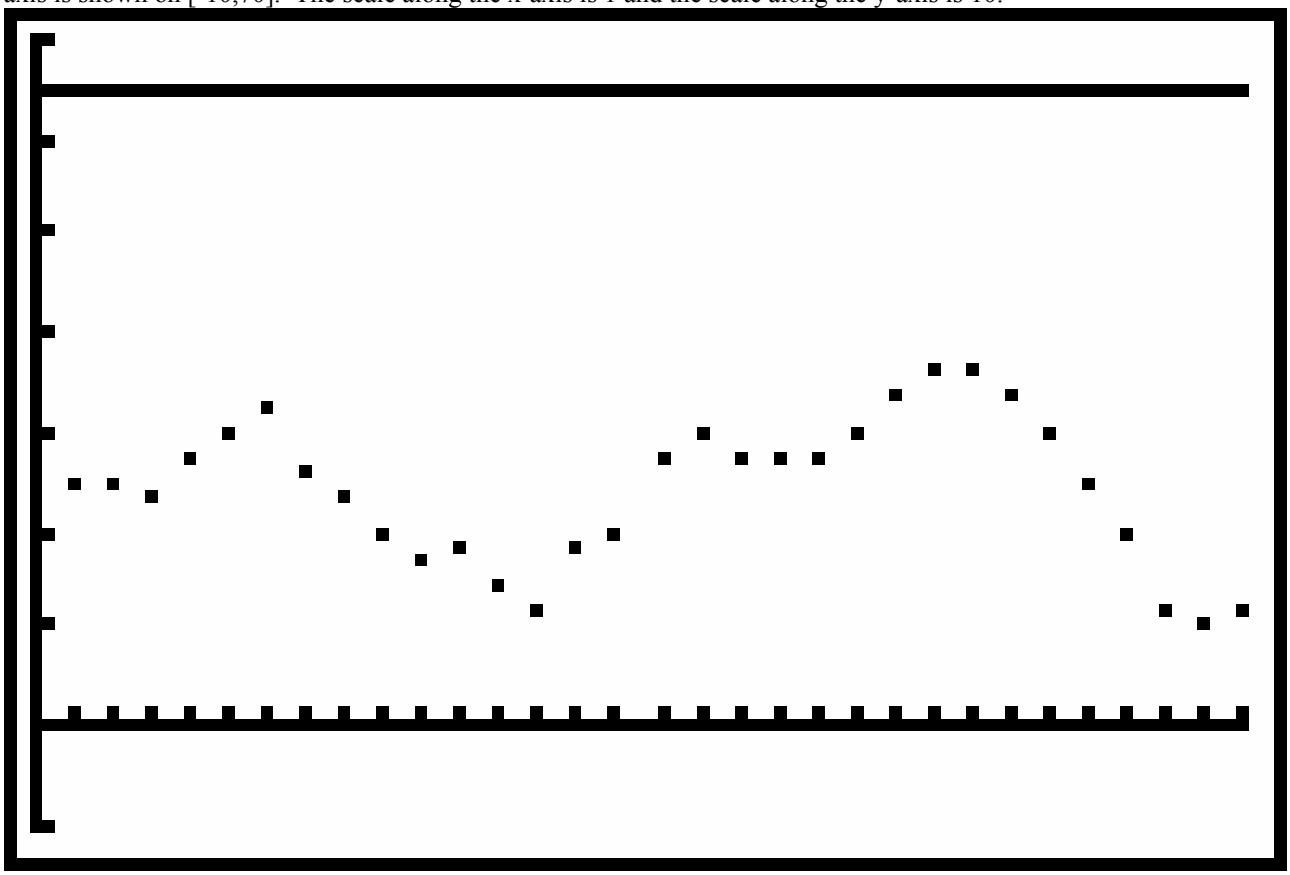
ENERGY DAY CURRICULUM IDEAS-MATH

The table below gives the average daily temperature for the 31 days of a cold January.

Date	Average Temperature
1	25
2	25
3	24
4	28
5	30
6	32
7	26
8	23
9	20
10	17
11	18
12	15
13	12
14	18
15	20
16	28
17	30
18	28
19	28
20	27
21	30
22	34
23	36
24	36
25	34
26	30
27	25
28	20
29	12
30	10
31	12

ENERGY DAY CURRICULUM IDEAS-MATH

On the graph below, a plot the data is shown along with the line y = 65. The x-axis is shown on [0,31]. The y-axis is shown on [-10,70]. The scale along the x-axis is 1 and the scale along the y-axis is 10.



a) Lightly sketch the area on the graph, which reflects the total number of degree-days.

b) Using 6 trapezoids, approximate this area. Show all work. Sketch the trapezoids in the graph above and use the table to identify precise y-values.

c) The amount of oil that a household or business uses depends on several factors, including square footage of the residence, burner efficiency, # of occupants, building use, etc. Suppose at a given home that 1 gallon of oil is burned for every 7 heating degree-days. Approximately how many gallons of oil will a homeowner go through during this month of January? Cost also varies season-to-season and even within each heating season itself. At $1.10 per gallon, what is your heating cost for January?

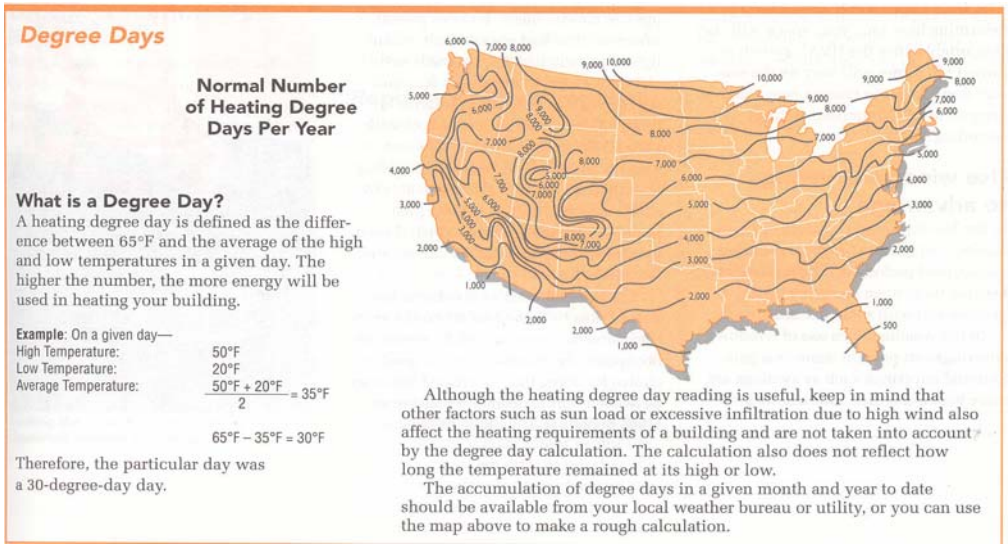
d) Suppose your oil company filled your tank on December 31st. Your tank holds 150 gallons of oil. When should the oil company come again? Provide a reasonable answer with a justification.

e) Just for fun, the quartic regression equation to fit the data is

$$y = -6.7708 * 10^{-4} * x^4 + .0343x^3 - .4922x^2 + 1.6925x + 25.3545 .$$

Enter this equation, and then show how one could use integration to determine a degree-day estimate for the month of January. Identify the set-up and the solution.

ENERGY DAY CURRICULUM IDEAS-MATH



Degree Days Map from How to Reduce Your Energy Costs, Advantage Publications and Insights, Boston, 1996.

M8 Reading Into Savings and Lights Out!

Upper Elementary/Middle School/High School Understanding electric meter readings and making comparisons.

Read the school's gas and electric meters. Compare your readings in a month. What is the cost of the energy used for the month? Estimate the cost for the year and compare to the school's actual cost.
Investigate your family's energy bill. What do the charges represent? What are the extra fees that are charged and what do they support?
http://www.cl-p.com/online/residential/consumer/meterread.asp
http://www.betterwaytosave.com/bwts/downloads/Meter%20Reader.pdf

Lights out!

Upper Elementary/Middle School/High School Taking meter reading to the next level.

For one week, read the school's electric meter. Make sure that you are reading it at the same time of day.
Compute the daily energy used and calculate the daily average electricity used.

Talk with you school's administration. Arrange to set aside one hour on one day when the school will commit to using as little electricity as possible. Brainstorm ideas as a class to list

ENERGY DAY CURRICULUM IDEAS-MATH

ways that energy can be eliminated or reduced. Prioritize the uses by electricity volume used and safety considerations. Discuss how daylighting could be used most effectively. Discuss having "cold lunch day" if the target time would affect the cafeteria.

Have students project the savings they think will be realized by the Lights Out efforts.
Read the meter for the day that included the Lights Out! activity.
Compare the reading to your daily average figures.
Discuss the data and what it indicates. Were the savings as much as expected?
How can the school incorporate conservation measures? Is more study needed? More publicity?

Disclaimer: This window sticker is only representative of the information contained on an actual window sticker, and may or may not match the actual window sticker on the vehicle itself. Please see your retailer for further information.

Vehicle Description VIN 1FAFP45X93F **325949**

MUSTANG

2003 GT CONVERTIBLE PREMIUM
4.6L 2V SOHC V-8 ENGINE
AUTO OVERDRIVE TRANSMISSION

Exterior
REDFIRE CLEARCOAT
Interior
DARK CHARCOAL LEATHER SPORT BUCKET SEATS

ENERGY DAY CURRICULUM IDEAS-MATH

Standard Equipment INCLUDED AT NO EXTRA CHARGE

SAFETY/SECURITY
. SECOND GENERATION AIRBAGS
. ABS/TRACTION CONTROL
. FRONT/REAR OUTBOARD THREE POINT SHOULDER/LAP BELTS
. SECURILOCK ANTI-THEFT
. REMOTE KEYLESS ENTRY
. 24-HOUR ROADSIDE ASSIST.

FUNCTIONAL
. 4.6L 2V SOHC V8 ENGINE
. 5-SPEED MANUAL TRANS
. POWER RACK PINION STEERING
. POWER 4-WHEEL DISC BRAKES
. CFC-FREE AIR CONDITIONING
. VAR. RATE REAR SUSPENSION
. P245/45ZR17 TIRES
. TRACTION-LOK REAR AXLE
. STAINLESS STL DUAL EXHAUST

EXTERIOR
. 17" ALLOY PREMIUM WHEELS
. FOG LAMPS
. REAR DECKLID SPOILER
. TINTED GLASS
. DUAL POWER MIRRORS
. VARIABLE INTERVAL WIPERS
. POWER CONVERTIBLE TOP
. GLASS/DEFROSTER RR. WINDOW

INTERIOR
. LEATHER-TRIM SPORT SEATS
. MACH 460 AM/FM STEREO W/IN-DASH 6-CD CHANGER
. PREMIUM SOUND
. POWER WINDOW/LOCK/DECKLID
. LEATHER WRAPPED/TILT STEERING WHEEL
. CONSOLE WITH ARMREST
. DUAL CUPHOLDERS
. ILLUMINATED VISOR MIRRORS

WARRANTY
. 3 YR/36,000 MI BUMPR-BUMPR

Price Information	**MSRP**
STANDARD VEHICLE PRICE	**$28,790**
Key Standard Equipment	
ORDER CODE 180A	
REAR SPOILER, SINGLE WING	
SEAT, POWER DRIVER'S	
SPEED CONTROL	
ABS BRAKING SYS/TRACTION CT	
AIR CONDITIONING, MANUAL	
6 CD CHANGER RADIO W/MACH	
WHEELS, 17" PREMIUM ALLOY	
Optional Equipment	
REDFIRE CLEARCOAT	
DARK CHARCOAL LEATHER	
.4.6L 2V SOHC V-8 ENGINE	
AUTO OVERDRIVE TRANSMISSION	815
.P245/45ZR17 BSW TIRES	
BLACK CONVERTIBLE ROOF	
CALIFORNIA EMISSIONS SYSTEM	
TOTAL VEHICLE & OPTIONS	29,605
DESTINATION & DELIVERY	625
TOTAL MSRP	**$30,230**

Disclaimer: Option pricing will be blank for any item that is priced as 0 or "No Charge".

TROPHY CASE

Best-Selling Car in Its Segment for 16 Years in a Row

Estimated Annual Fuel Cost: $1,162

CITY MPG
18

HIGHWAY MPG
24

Vehicle Engine Information
2003 MUSTANG, 4.6L ENGINE (FEEDBACK FUEL SYSTEM), 8 CYLINDERS, FUEL INJECTION, CATALYST, 4-SPEED AUTO. TRANSMISSION.
Actual mileage will vary with options, driving conditions, driving habits and vehicle's condition. Results reported to EPA indicate that the majority of vehicles with these estimates will achieve between 15 and 21 mpg in the city and between 20 and _ mpg on the highway.
For Comparison Shopping all vehicles classified as **SUBCOMPACT** have been issued mileage ratings from _ to _ mpg city and _ to _ mpg highway.