

ENERGY ASSIGNMENT

DUE

HOW MUCH ENERGY IS USED BY YOUR LIFE IN A WEEK?

You will be estimating most items. One suggestion is for a typical winter week, keep track of your activities and energy usage, then estimate for both weekdays and weekends.

This is an individual project. The information should be presented neatly and clearly, and all assumptions, estimations and calculations understandable and legible.

The paragraphs of conclusions for each sections, and at the end should refer to actual measurements as well as methods used.

It is very important that you check your units and calculations as you go along.

For each category, list the calculations you used to determine it, the assumptions (sources) and estimations you had to make and the value in Joules, Calories, KW-Hrs, and Jelly Doughnuts.

Write conclusions about any sources of error, or other information. Make sure you include totals. Compare the different methods used. Compare the different types of energy. Which is most/least accurate? How much are you normal or non-average for each? ** What did you learn from this, and how will it change your life/attitude/outlook? Be Prepared to share your information with the class and discuss your results.

You should have a detailed sheet with lists and calculations **FOR EACH TYPE!**

You should have a summary sheet showing final totals for each type, the results in different units, and total calculations.. Include a spot to compare yourself to the class average.

Personal/Mechanical in a week (finish by Feb break?)

Energy used to move your body estimated at least two different ways:

1. Estimate total KE ($\frac{1}{2}mv^2$) for a week (using average velocity), and total GPE (weight times height = mgh) and work (weight times Dis= $F*D$) for a week. (Add together)

2. Energy used to move your body from charts, based on activities

Compare the two methods and try to conclude which is most accurate, what you found out, some reasons while they are different...

Energy Intake (Food, etc...) Does it equal the personal energy output? Why/Why not? What does this tell you?

Electrical in a week (Calculate two different ways)

Use chart/sheets of information to estimate for each appliance, power times time.

Compare to electrical bill/actual usage from electrical meter

Shower Energy in a week: both heating and moving the water. (note: this should be already included in the electrical & heating, unless you have some sort of gravity pump)

Heating your House/Water:

Transportation:

OTHER TYPES: (both input and output)

SCORING RUBRIC PHYSICS ENERGY PROJECT

CONTENT		40
Mechanical Energy	10	
Personal Energy	5	
Food	5	
Electrical	5	
Heat	5	
Transportation	5	
Shower	5	
OVERALL CONCLUSIONS		30
Each Section	7	
Overall	7	
Class Comparison	7	
QUALITY		17
Organization	6	
Accuracy	6	
Clarity	4	
INSIGHT		12
Analysis	4	
Class Discussion	4	
Implications	4	

SOME SAMPLE SECTIONS (way shorter than your project):

MECHANICAL ENERGY:

1) I move up the stairs 5 times a day. My mass is 20 kg, and the stairs are 10 m high. So my gravitational potential energy for a week is $mgh * 5 \text{ times} * 5 \text{ days}$. (I don't move on weekends!)

$$20 \text{ kg} (9.8) * 10 \text{ m} = 1960 \text{ Joules} * 5 = 9800 \text{ Joules} * 5 \text{ days}$$
$$\text{GPE} = 49,000 \text{ Joules per week}$$

I walk up and down the hallway 20 times a day, and it is 50 m long. Over a typical day, I walk another 100 m total (see my chart for list of walking). Then I walk another 200 m on the weekend.

So that means I walk about 1400 m total in a week. That's over 2 hrs a day $* 60 * 60 = 7200$ sec

So my average velocity is $1400 / 7200 = .2 \text{ m/s}$ in a week for my average velocity. My kinetic energy is $\frac{1}{2} m v^2 = .5 (20) (.2)^2 = 0.4 \text{ Joules!}$

The work I do to move myself is my Weight * Distance = $196 \text{ N} * 1400 = 280,000 \text{ Joules}$

My total mechanical energy is GPE + KE (I won't bother counting my elastic potential energy because I am not a spring!!!) $\text{ME} = 49000 + .4 + 280,000 = 330,000 \text{ Joules (about)}$

2) I now compare to my activities list I got from countmycalories.com....

I list out my sleeping (50 Cal/hr) * 10 hrs/day * 7 days = 3500 Cal

My running/walking 120 Cal/hr * 10 hrs/week = 12000 Cal

My using a rotary saw is 100 Cal/hrs * 2 hrs/week = 200 Cal

My other activities add up to 11,000 Cal a week.....

So my total for a week is 27,000 Cal for the week....

$27,000 \text{ Cal} * 4187 \text{ Joules/Cal} = 100,000,000 \text{ Joules a week}....$

I guess the mechanical energy way one doesn't account for all the stuff I do!!!

3) My food intake a day is ham egg and cheese sandwich: 300 Calories,

salad : 400 Cal

pizza : 1300 Cal

other : 1000 Cal

So that's 3000 Cal a day, or 21,000 Cal a week $* 4187 = 80,000,000 \text{ Joules}...$ I should be losing weight!

ELECTRICAL:

1) My bill for the month is \$40, and is about 600 KW-Hrs a week.
2) When I read my electric meter it is 1249180 on Monday and 124900 the next week, so I used 720 KW-Hrs that week...

3) I add up all my devices,

I have 5 100 Watt light bulbs I use for 5 hrs each a week.

$$0.1 \text{ KW} * 5 \text{ hrs} = .5 \text{ KW Hrs} * 5 = 2.5 \text{ KW Hrs a week}$$

I have a 500 Watt TV I use for 4 hrs a day

$$0.5 \text{ KW} * 4 * 7 = 14 \text{ KW Hrs a week}$$

I have a 1100 Watt fridge I use for 168 hrs a week

$$1.1 * 168 = 200 \text{ KW Hrs...}$$

So my total adds up to be about 350 KW Hrs a week, I must have forgot some stuff..., 900 million Joules!

My Shower:

My showerhead says 10 gal/min, and I take a 10 min shower, so I use 100 gallons.

I also held a cup under the faucet for 10 seconds, and got 1.5 gallons (8 gal/min)

I convert that to kg (gal to L to Kg) and get that I use 380 Kg of water in a shower.

It gets lifted up from my basement for 10 m, so the work is $mgh=380*9.8*10=36,000$ Joules

To Heat the water it goes from 2 degrees Celsius to 32 degrees Celsius (cold to hot)

30 degrees change....

So the Calories used is $380 \text{ Kg} * 30 \text{ degrees} = 10,000$ Calories = 41,870,000 Joules to heat it!

so my energy for a shower is 41,900,000 Joules!

My Heat:

I get my oil heat bill and figure it uses 40 gallons of oil a month, and convert it to Joules.
60 billion Joules!

My Car:

I travel 30 miles a day, and my car gets 20 mpg, so I use 1.2 gal a day times 7 days for 10 gallons of gas a week, and I convert that to Joules...

1.5 billion Joules

I add up my Mech Energy plus Electrical plus Heat plus Car plus other and get

About 63 billion Joules total! = 15 million Calories, 35,000 Jelly DoughnutS!

UNIT CONVERSIONS FOR ENERGY

KNOW↓	WANT→		Joules	kilocalories(food Calories)
1 Joules	J(N-m)	=	1 J	0.000238834 Calories
1 kilocalories(food Calories)	Calories	=	4187 J	1 Calories
1 British Thermal Units	BTU	=	1055 J	0.251996 Calories
1 Kilowatt-Hours	KWHr	=	3599406 J	861 Calories
1 Foot-Pounds	ft-lbs	=	1.356 J	0.000324048 Calories
1 FuelOilGallons		=	154449647 J	36889 Calories
1 GasolineGallons		=	134659880 J	32168 Calories
1 Coal kilograms		=	20992945 J	5021 Calories
1 Ergs		=	9.99835E-08 J	2.38846E-11 Calories
1 Grams of Fat		=	39776 J	9.5 Calories
1 Jelly Doughnut		=	1046750 J	250 Calories
1 full cord wood		=	21101120 J	5040 Calories
1 cu ft nat gas		=	1076157 J	257 Calories

KNOW↓	WANT→		FuelOilGallons	GasolineGallons
1 Joules	J(N-m)	=	6.4746E-09 FuelOilGallons	7.42608E-09 GasolineGallons
1 kilocalories(food Calories)	Calories	=	2.71078E-05 FuelOilGallons	3.10865E-05 GasolineGallons
1 British Thermal Units	BTU	=	6.83107E-06 FuelOilGallons	7.83368E-06 GasolineGallons
1 Kilowatt-Hours	KWHr	=	0.023290596 FuelOilGallons	0.026729597 GasolineGallons
1 Foot-Pounds	ft-lbs	=	8.77838E-09 FuelOilGallons	1.00324E-08 GasolineGallons
1 FuelOilGallons		=	1 FuelOilGallons	1.146771742 GasolineGallons
1 GasolineGallons		=	0.872013116 FuelOilGallons	1 GasolineGallons
1 Coal kilograms		=	0.135943349 FuelOilGallons	0.155895991 GasolineGallons
1 Ergs		=	6.46961E-16 FuelOilGallons	7.42489E-16 GasolineGallons
1 Grams of Fat		=	0.000257524 FuelOilGallons	0.000295322 GasolineGallons
1 Jelly Doughnut		=	0.00677696 FuelOilGallons	0.007771634 GasolineGallons

KNOW↓	WANT→		British Thermal Units	Kilowatt-Hours
1 Joules	J(N-m)	=	0.000947969 BTU	2.77822E-07 KWHr
1 kilocalories(food Calories)	Calories	=	3.96 BTU	0.001163 KWHr
1 British Thermal Units	BTU	=	1 BTU	0.000293297 KWHr
1 Kilowatt-Hours	KWHr	=	3412 BTU	1 KWHr
1 Foot-Pounds	ft-lbs	=	0.001280675 BTU	3.76616E-07 KWHr
1 FuelOilGallons		=	146390 BTU	42.9 KWHr
1 GasolineGallons		=	127654 BTU	37.4 KWHr
1 Coal kilograms		=	199001 BTU	5.83 KWHr
1 Ergs		=	9.47817E-11 BTU	2.77778E-14 KWHr
1 Grams of Fat		=	37.7 BTU	0.011 KWHr
1 Jelly Doughnut		=	992 BTU	0.29 KWHr
1 full cord wood		=	20000000 BTU	5.86 KWHr
1 cu ft nat gas		=	1020 BTU	0.299163195 KWHr

UNIT CONVERSION

1 Joules	J(N-m)	=	4.76348E-08	Coal kilograms		Ergs
1 kilocalories(food Calories)	Calories	=	0.000199406	Coal kilograms	10001606.4	Ergs
1 British Thermal Units	BTU	=	5.02494E-05	Coal kilograms	41868000000	Ergs
1 Kilowatt-Hours	KWHR	=	0.171457886	Coal kilograms	10558701000	Ergs
1 Foot-Pounds	ft-lbs	=	6.43531E-08	Coal kilograms	3.6E+13	Ergs
1 FuelOilGallons		=	7.356005321	Coal kilograms	13558181.04	Ergs
1 GasolineGallons		=	6.414533119	Coal kilograms	1.54569E+15	Ergs
1 Coal kilograms		=	1	Coal kilograms	1.34682E+15	Ergs
1 Ergs		=	4.76272E-15	Coal kilograms	2.09964E+14	Ergs
1 Grams of Fat		=	0.001894353	Coal kilograms	1	Ergs
1 Jelly Doughnut		=	0.049851404	Coal kilograms	3.97746E+11	Ergs
				Coal kilograms	1.0467E+13	Ergs

WANT→

KNOW↓			Foot-Pounds		grams of CO2 released	
1 Joules	J(N-m)	=	0.73768021	ft-lbs		gms CO2
1 kilocalories(food Calories)	Calories	=	3088	ft-lbs	0.000142904	gms CO2
1 British Thermal Units	BTU	=	778.16932	ft-lbs	0.598211642	gms CO2
1 Kilowatt-Hours	KWHR	=	2655223.9	ft-lbs	0.15074804	gms CO2
1 Foot-Pounds	ft-lbs	=	1	ft-lbs	514.3736555	gms CO2
1 FuelOilGallons		=	113916206.8	ft-lbs	0.000193721	gms CO2
1 GasolineGallons		=	99336426	ft-lbs	22068.00552	gms CO2
1 Coal kilograms		=	15486157.88	ft-lbs	19243.59018	gms CO2
1 Ergs		=	7.37562E-08	ft-lbs	2999.999977	gms CO2
1 Grams of Fat		=	29336	ft-lbs	1.42882E-11	gms CO2
1 Jelly Doughnut		=	772000	ft-lbs	5.683010596	gms CO2
1 full cord wood		=	15563386.4	ft-lbs	149.5529104	gms CO2
1 cu ft nat gas		=	793732.7064	ft-lbs	3014.960793	gms CO2

WANT→

KNOW↓				grams of fat		JellyDoughnut
1 Joules	J(N-m)	=	2.51405E-05	grams of fat	9.55338E-07	JellyDoughnut
1 kilocalories(food Calories)	Calories	=	0.105263158	grams of fat	0.004	JellyDoughnut
1 British Thermal Units	BTU	=	0.026525895	grams of fat	0.001	JellyDoughnut
1 Kilowatt-Hours	KWHR	=	90.63157895	grams of fat	3.444	JellyDoughnut
1 Foot-Pounds	ft-lbs	=	3.41103E-05	grams of fat	1.29619E-06	JellyDoughnut
1 FuelOilGallons		=	3883.125731	grams of fat	147.56	JellyDoughnut
1 GasolineGallons		=	3386.133368	grams of fat	128.67	JellyDoughnut
1 Coal kilograms		=	528.5938187	grams of fat	20	JellyDoughnut
1 Ergs		=	2.51417E-12	grams of fat	9.55384E-14	JellyDoughnut
1 Grams of Fat		=	1	grams of fat	0.038	JellyDoughnut
1 Jelly Doughnut		=	26.31578947	grams of fat	1	JellyDoughnut