AP Environmental Science 2012-2013 Section 1
Lambert High School
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Welcome to AP Environmental Science! This course is designed to be the equivalent of a one-semester, introductory college course in Environmental Science. The goal of the AP Environmental Science course is to provide students with the scientific principles, concepts and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems and to examine alternative solutions for resolving or preventing them.
This summer assignment is designed to prepare you for the content of the class. There are 6 parts to this assignment. **All work that is not an essay portion of the energy audit is to be hand written and must be your own work. You must show your work on all math problems. This assignment will be a significant portion of your first 9 week grade.**

SECTION A. Vocabulary.

Examine the concepts/terms below and become familiar with them. This is accomplished by providing a simple definition of each term listed. This list will serve as the beginning of your personal APES glossary for the course.

Organic vs. Inorganic
Natural vs. Synthetic
Anthropogenic
Producers/Autotrophs
Consumers/Heterotrophs
Decomposers vs. Detritivores
Rocks vs. Minerals
Radioactive decay
Half life
Plate Tectonics
Weathering
Erosion
Climate vs. Weather
Climate Change
Greenhouse Effect vs. Global Warming
Photosynthesis (reactants and products)
Primary Productivity
Electromagnetic Spectrum
Elements
Compounds
Ions
Law of Conservation of Matter
Cellular respiration (reactants and products)
Metabolism
Entropy
Aerobic vs. Anaerobic
Kinetic vs. Potential Energy
1st Law of Thermodynamics
2nd Law of Thermodynamics
Organism
Species
Population
Community
Ecosystem
Mutation
Adaptation
Gene

Chromosome
Trait
Gene pool
Biodiversity
Natural Selection
Endangered vs. Threatened

SECTION B. **Chemistry** is a pre-requisite/co-requisite for this class. Please write out the name of each molecule below.
Write out the full name of each of these chemical abbreviations and list where you feel these compounds/molecules fit in with the topic of environmental science.

CO_2
P
CO
PO_4
$C_6H_{12}O_6$
S
CH_4
SO_2
H_2
Cl
N_2
K
NO_2
NaCl
NO_3
Pb
NH_3
U
NH_4
Rn
O_2
Hg
O_3
H_2O
NO_x
SO_x

SECTION C. **Acronyms.** Below are acronyms commonly used in class and on the AP Environmental Exam. Please fill in what the acronym stands for.

USGS _____

NEPA _____
FIFRA _____
FFDCA _____
CERCLA _____
RCRA _____
ESA _____
CITES _____
WTO _____
BOD _____
GNP _____
PPM _____
BTU _____
CDC _____
FEMA _____
NOAA _____
OSHA _____
EPA _____
FDA _____
NIH _____

SECTION D. **Laws, Acts and Administrations**. Fill out the **purpose** of the following. Many more laws, acts and administrations will be introduced at a later date. This is the minimum you need to know upon entry.

Kyoto Protocol:
Montreal Protocol:
Helsinki Convention:
Rio Earth Summit:
Cairo Conference:
Stockholm Declaration:
Antarctic Treaty:
CITES:
NOAA:
CERCLA:
Clean Water Act:
Clean Air Acts:
National Environmental Policy Act:
FFDCA:

SECTION E. **Math readiness.** Review this section and be ready to work out problems throughout the year. Math will be seen on the APES Exam and work will be completed WITHOUT a Calculator!!!

Prerequisite Basic Mathematical Skills

Scientific Notation

Thousand = 10^3 =1,000
Million = 10^6 =1,000,000 (people in the US)
Billion = 10^9 =1,000,000,000 (people on Earth)
Trillion = 10^{12} =1,000,000,000,000 (National debt)
- When using very large numbers, scientific method is often easiest to manipulate. For example, the US population is 300 million people or $3x10^8$
- When adding or subtracting, exponents must be the same. Add the numbers in front of the ten and keep the exponent the same.
- When multiplying or dividing, multiply or divide the number in front of the ten and add the exponents if multiplying or subtract the exponents if dividing
Ex. $9x10^6 / 3x10^2 = (9/3) \times 10^{(6-2)} = 3 \times 10^4$

Write the following numbers in scientific notation:
1. One million
2. Forty eight thousand
3. 5 878 300
4. Six hundred
5. 0.015

Convert the following to regular notation:
1. 2.45×10^{4}
2. 9.1×10^{-2}
3. 7.5469×10^{-4}
4. 1.970×10^{5}
5. 8×10^{1}

Use Scientific Notation (and only Scientific Notation) to solve the following problems:
1. $(6.235 \times 10^{-8})(6.7 \times 10^{2}) =$
2. $(2.456 \times 10^{4}) \div (1.436 \times 10^{13}) =$
3. $(2.34 \times 10^{-6}) + (3.3 \times 10^{4}) =$
4. $(1.45 \times 10^{6}) - (2.30 \times 10^{-3}) =$
5. $(9.81 \times 10^{12}) \times (4.02 \times 10^{3})$

Percentages

17% = 17/100 = .17
- Remember that "percent" literally means divided by 100.
- Percentage is a measure of the part of the whole. Or part divided by whole.
- 15 million is what percentage of the US population?
  15 million / 300 million = .05 = 5%
- What is 20% of this $15 bill so that I can give a good tip?
  $15 x .20 = $15 x 20/100 = $3

1) A population of deer had 200 individuals. If the population grows by 15% in one year, how many deer will there be the next year?
2) One year I had 40 AP Environmental Science students and the next year I had 50 Environmental Science students, what percentage did the population of APES students grow by?
3) If 35% of a natural area is to be developed, leaving 500 acres untouched, how many acres are to be developed?
4) If the concentration of mercury in a water supply changes from 65 ppm to 7 ppm in a ten-year period, what is the percentage change of the mercury concentration?
5) Fifteen million is what percentage of the U.S. population of 300 million?
6) What is 20% of a $34.80 bill so you can give a good tip?
7) Calculate the percentage growth rate for a country with a population of 6 million; in a year in which it had 100,000 births, 70,000 deaths, 30,000 immigrants, and 50,000 emigrants.

Dimensional Analysis

You should be able to convert any unit into any other unit accurately if given the conversion factor.
Online tutorials are available:
http://www.chemprofessor.com/dimension_text.htm
http://www.chem.tamu.edu/class/fyp/mathrev/mr-da.html

Common Prefixes

m (milli) =1/1000 $=10^{-3}$
c (cent) =1/100 $=10^{-2}$
k (kilo) =1000 $=10^{3}$
M (mega) =1,000,000 $=10^{6}$
G (giga) =1,000,000,000 $=10^{9}$
T (tera) =1,000,000,000,000 $=10^{12}$

Math Problems

Answer the questions. Use a separate sheet of paper if necessary. Show all work

1. 8,640 mm = __cm
2. 175 lbs = __ kg
3. 33.2 kg/L = __ kg/mL

4. 3.8 Km/sec = __ miles /year
5. A 100 square mile area of National Park is how many acres? How many hectares?
6. A factory using four million BTU's of energy each month is using how many kilowatt-hours of energy?
7. Twelve hundred metric tons of solid waste is how many kilograms?
8. The total amount of freshwater on earth is estimated to be 3.73 x 108 km3. What is the volume in cubic meters? In liters?
9. Traveling at 70 miles/hour, how many minutes will it take to drive 175 miles to San Antonio?
10) Electricity costs 6 cents per kilowatt hour. In one month one home uses one megawatt hour of electricity. How much will the electric bill be? (Be sure to look at the prefixes chart for the conversion of kilo to mega)
11) Your car gets 15 miles to the gallon and your friend's car gets 25 miles to the gallon. You decide to go on a road trip to Virginia Tech, which is 300 miles away. If gas costs $4 per gallon and you decide to split the gas money, how much money will you save in gas by driving your friend's car?

The next section is the energy audit and will take 14 days to complete.

Energy Efficiency in Your Home

Why do you hear the words "turn off the lights" at home? Do you know how much electricity is used by the light bulbs in your room and how much it costs your parents each month? If you do not, now is the time to find out. Utility (gas, electric, phone, water, etc) prices are something that you need to become aware of. Why should you learn about this? It doesn't affect you right now… does it? In reality, it does. When utility bills are high, more money is used to pay them and less money goes to the other things you enjoy. By the time you get out of school, a major portion of the money you spend each month could go to utility bills due to the rising cost.

Objective of Project:

Use the following charts on the next pages to review your home. Using the formulas calculate approximate electrical usage in your home. Once you have completed the at home portion bring your results back to class for a discussion on what items used the most.

YOU HAVE 4 MAJOR SECTIONS WHICH YOU WILL BE GRADED ON. LOOK AT RUBRIC FOR GUIDANCE IN YOUR PROJECT.

This worksheet will not be handed in. What you turn in will be a word document with all parts A-D and a Bibliography page with your references in MLA format.

Start here: ANALYSIS OF ELECTRICITY CONSUMPTION

A. **Reading / Recording Electrical Consumption Chart**

Read the electric meter at the same time everyday for a 15 day period and record the value. Make daily notes on the patterns of electrical use in your household, particularly the use of large appliances. Note the usual settings for the AC unit and hot water heater, amount of cooking, type of lights, clothes washing**,** etc. Also record notes on the weather that may affect heating or cooling. **YOU NEED TO CREATE A DATA TABLE THAT LOOKS SIMILAR TO THE ONE BELOW.**

HELPFUL HINT: TO CALCULATE DAILY USAGE SUBTRACT TODAY'S METER READING IN KWh FROM YESTERDAY'S METER READING IN KWh. You will not have a daily usage value for your very first day.

Ex: 92284KWh-92178KWh=106 KWh daily usage.

Table 1 : Meter readings, observations and usage notes for the period of April 1 - April 14.

DATE	METER READING (KWh)	DAILY USAGE	WEATHER OBSERVATIONS	APPLIANCE USAGE
4/1	92178	--	sunny, 30°C / 21.5°C	ac setting - 24°C
4/2	92284	106	partly cloudy	laundry day

B. There are 5 main sections to PART B.

B-Part I:

Use the attached worksheets (LIGHTING,APPLIANCES/ELECTRONICS, and a HEATING/

AIR CONDITIONING) from Sawnee EMC to determine the energy consumption for light bulbs

And the various major appliances in your home. Please keep in mind you will have three separate lighting worksheet out-two are math calculations.

LIGHTING WORKSHEET

List the number of light bulbs in your home:

Area	# of Lights	Total Watts	kWh Conversion (watts/1000)	Approximate Hours Used Per Day	Total kWh (kWh x hours)	Cost per Day (Total kWh *$.11)	Cost per Month (Cost *30 days)
Bedrooms:							
Kitchen:							
Living Area:							
Garage/Storage/Utility							

Bathrooms							
Outdoor lighting							
All Others							
Total:							

B-PART II:

Now, that you have looked at the lighting in your home, what savings could you gain by changing the wattage of the lights? Go to www.homedepot.com or www.lowes.com to find the cost of a CFL or halogen light bulb. Take your total Watts and divide it by the # of lights to get an average wattage for your light bulbs, and then recalculate your cost using a lower wattage bulb that you found on home depot's or lowes website that is lower than your average on the worksheet below.

AVERAGE COST

Area	# of Lights	Average Watts	Total Watts (# of lights x average watts)	kWh Conversion (watts/1000)	Hours Used Per Day	Total kWh (kWh x hours)	Cost per Day (Total kWh *$.11)	Cost per Month(Cost *30 days)
Bedrooms:								
Kitchen:								
Living Area:								
Garage/Storage/Utility								
Bathrooms								
Outdoor lighting								
All Others								
Total:								
Example: Bedrooms	10	60	600 Watts	.600 kWh	5 hours	3 kWh	$.33	$9.90

LOWER WATTAGE COST

Area	# of Lights	Lower Watt bulb	Total Watts (# of lights x lower	kWh Conversion	Hours Used Per Day	Total kWh (kWh x	Cost per Day (Total kWh *$.11)	Cost per Month(Cost *30 days)

			watts)	(watts/1000)		hours)		
Bedrooms:								
Kitchen:								
Living Area:								
Garage/Storage/Utility								
Bathrooms								
Outdoor Lighting								
All Others								
Total:								
Example: Bedrooms	10	15	150 Watts	.150 kWh	5 hours	.750 kWh	$.083	$2.48

COST COMPARISON

Area	Cost Per Month Average Bulb	Cost Per Month Low Watt Bulb	Savings per Month (average – lower watt cost)	Cost of Replacement bulb*	Total Cost Of Replacement Bulbs(# of bulbs x cost)	Payback in months (Replacement/ savings per month)	Is this a good Upgrade?
Bedrooms:							
Kitchen:							
Living Area:							
Garage/Storage/Utility							
Bathrooms							
Outdoor Lighting							
All Others							
Total:							
Example: Bedrooms	$9.90	$2.48	$7.42	$2.25	$22.50	3.03 months	Yes

B-PART III: APPLIANCES / ELECTRONICS

HINT: YOU WILL NOT HAVE A MAJORITY OF THESE APPLIANCES IN YOUR HOUSE!!!!

Calculate approximate appliance usage in the chart below along with CO_2 output in lbs. In order to determine the amount of CO_2 released, multiply the number of KWh by 1.5 lbs for each major appliance used in your home. This is your home's carbon footprint.

Appliance	Typical Wattage	# of Appliances	Total Watts	Hours Per Day Used	Total kWh per Day	Monthly Cost (Total kWh x $.11) x 30 days	CO_2 output In lbs
Air Purifier	120						
Ceiling Fan w/o light	50						
Clock - Electric	3						
Clothes Dryer - Electric	5000						
Clothes Washer (not including hot water cost)	1200						
Coffee Maker	900						
Computer with Monitor	270						
Dehumidifier - 40 pint	625						
Dishwasher (With Dry Cycle)	1000						
Dishwasher (Without Dry Cycle)	250						
DVD	60						
Fax Machine	10						
Fish Tank (10 Gallon)	80						
Freezer - Upright/Chest 17 cu. ft	600						
Freezer - Upright/Chest 17 cu. ft. – Frost free	600						
Hair Dryer (Hand Held)	1500						
Home Stereo Receiver (while on)	100						
Microwave Oven	1500						

Appliance	Typical Wattage	Number of Appliances	Total Watts	Hours Per Day Used	Total kWh per Day	Monthly Cost (Total kWh x $.11) x 30 days	CO2 In Lbs.
Oven	5000						
Range - Large Surface Unit	2400						
Range - Small Surface Unit	1200						
For Refrigerators use 8 hrs as estimate of Hours per Day Used							
Refrigerator - 14 cu. ft.	226						
Refrigerator - 14 cu. ft. – Frost free	383						
Refrigerator - 17 cu. ft – Frost free	463						
Refrigerator - 19 cu. ft. – Frost free	540						
Refrigerator - 21 cu. ft. – Frost free	572						
Refrigerator - Freezer 21 cu. ft.- Side by Side	783						
Refrigerator - Freezer 24 cu. ft. – Frost free	653						
Refrigerator - Freezer 25 cu. ft. - Side by Side	841						
Swimming Pool - Above Ground	500						
Swimming Pool -1H.P. motor	1000						
Swimming Pool -3/4 H.P. motor	750						
Swimming Pool - 2 H.P. motor	2000						
Telephone - Cordless	5						
Television - 25 inch	123						
Television - 27 inch	125						
Television - 32 inch	130						
Television - 36 inch	133						
Television - 43 inch	200						
Television - 55 inch	220						
Television - 60 inch	240						

Television Cable Converter Box	35						
Television/DVD/VCR Combination	120						
Toaster	1000						
Toaster Oven	1500						
Vacuum - Regular	1440						
VCR	45						
Video Game	200						
Water Heating - 40 Gallon tank (use 100 hr estimate for run time)	4500						
Well Pump 1 H.P. (Use 60 hr estimate for run time)	1000						
Other:							
Other:							
Other:							
Totals:							

This section will help you in your discussion essay!!!!

Were there any electronics or appliances that surprised you in cost? Another hidden factor in electronics is "phantom loads". This is also called vampire appliances. A phantom load is the amount of power that some electronics will still consume while they are plugged in but they are turned off. Items such as TV's, Stereo's, computers, and battery chargers will still consume small amounts of kilowatts while they are plugged in but you have turned them off. The way to avoid this drain is to unplug items that you do not use often to avoid this wasted energy. With all the electronics that are in homes at this time, these small loads can add up quickly.

How can you save on these items? Make sure that you shut off electronic devices when you are finished with them. If you are looking to replace an electronic device, make sure you review its energy consumption and consider going with an ENERGY STAR brand. ENERGY STAR lists products that they have rated on their Web Site at www.energystar.gov. You can compare consumption data on different appliances you are considering.

B-PART IV:

Heating and Air Conditioning

Heating and Air conditioning is one of the biggest contributors to utility bills. We recommend a temperature setting of 78 degrees Fahrenheit during the summer and 68 degrees Fahrenheit during the winter. Air conditioners and heat pumps are rated per "ton". A ton when referring to Air conditioning is not weight; it's the capacity for cooling. Ask your parents how many tons of air conditioning your home has, if they are not sure, use an estimate of 600 square feet of living space per ton. So if your house has 1800 square feet of living space in it and only 1 air conditioner then a good estimate for the size of your air conditioner will be 1800/600 = 3 tons. If you have 2 or more air conditioners, estimate how much area each one serves and do the same calculation.

Calculate appliance usage:

Air conditioner or Heat pump	**Typical Wattage**	**Number of Units**	**Total Watts**	**Hours Per Day Used**	**Total kWh Per Day**	**Monthly Cost (Total kWh x $.11) x 30 days**
For air conditioners/heat pumps use 12 hrs as estimate of Hours per Day Used during summer, if conducting audit during winter, use 6 hours for heat pump						
Air Conditioner - (window unit) 7,000 BTU	750					
Air Conditioner or Heat Pump - central air 1.5 ton unit*	1800					
Air Conditioner or Heat Pump - central air 2 ton unit*	2400					
Air Conditioner or Heat Pump - central air 2.5 ton unit*	3000					
Air Conditioner or Heat Pump - central air 3 ton unit*	3600					
Air Conditioner or Heat Pump - central air 3.5 ton unit*	4200					
Air Conditioner or Heat Pump - central air 4 ton unit*	4800					
Air Conditioner or Heat Pump - central air 5 ton unit*	6000					
Auxiliary Heat in Air handler for Heat Pump (furnace for heat pump) use 2	10000					

hrs/day for winter calculations only						
Totals:						

*Air conditioners and Heat pumps use similar amounts of electricity while cooling. Heat pumps also consume this amount while running during the winter until the auxiliary heat in Air Handler engages at which point heat pump consumption can triple. Cooling numbers estimated at 12 hrs/day however run time varies with outside temperature

B-PART V:

According to ENERGY STAR, replacing a unit that is more than 12 years old could result in a 30% decrease in the operating cost for that unit. Although your air conditioner may not be 12 years old, using one of your calculations above, estimate how much savings you could experience if you decreased the operating cost by 30%:

Air Conditioner or Heat Pump	Monthly Cost	Savings: (Monthly cost x 30%)
Example: 3 ton AC	$142.56	$42.77

Outside temperature is the main factor in how much air conditioners and heat pumps run. As the temperature outside rises during the summer units work harder to keep the heat out of the interior of the home. Air leaks, insufficient insulation, cracked weather stripping, loose window locks, and other issues allow air to seep into the home during both winter and summer. This causes units to work harder to heat and cool the house. Sealing air leaks and increasing insulation help combat this increase in air conditioning or heating.

Part C: You need to write a 1 page paper describing your residence.

The following topics should be described SPECIFICLY. Vague descriptions will be given no credit. I have Bulleted the building materials that you need to write about as a guide. Also, what other features do you have in your home that may adjust your energy consumption. As an example do you have a hot tub, pool, or tanning bed in your home? You need to include a picture of your electric meter, gas meter, and home on another page.

Materials to discuss include:

a. insulation (type and R-value)

b. shading by trees or shrubbery

c. condition, composition, and color of the roof

d. air circulation in the attic

e. tightness of fit for doors and windows

f. color of house (absorb or reflect heat ?)

g. any other features that may affect the house's heat balance

PART D.

Discussion - (MAXIMUM length – 2 pages)

In this section, analyze what have you learned through this project. You may also read the background information I have included below to help you format your paper. Questions to answer include making 2 detailed suggestions about how you and the members of your household can conserve energy by changing patterns of consumption. Next, examine the economic and pollution impacts of these changes. In some cases, changes may be well intended but may carry an economic disadvantage (i.e. that may not be cost effective at this time) or, you may be thwarted in attempts to make certain alterations in your lifestyle. You need to find 3 resources to reference in your discussion paper. You must also include ONE chart or graph found from your research. These questions may help drive the format of your paper:

1. Areas where reduced consumption will result in monetary savings (for you).
2. Changes on a personal or family level that will be reflected in an improvement in a larger, shared system, e.g. reduced electrical consumption leading to reduced fuel consumption by the utilities, less air pollution, etc.
3. Changes that should or could be made at the personal or family level, but which are ineffective unless the system is changed at higher levels.

Background Information:

Electric Bill:

An electric bill consists of the total amount of kilowatts that are used by a member of the power company each month. The kilowatts are recorded on a meter that is located on the side of the house. Each month the meter is read by the power company and the old reading is subtracted from the new reading to determine the bill for the month. For example, if your meter is reading 12450 today and 30 days ago it was reading 12000 then you will be billed for 450 kilowatt hours (kWh) for the month.

Formulas to remember:

Watt = Unit of electrical power

Watts = Volts x Amperes

1000 Watts = 1 kilowatt-hour (kWh)

Simple Payback = install cost/annual savings

Use of Electricity Determines the Bill:

Why does the bill change each month? The bill is determined by how often an item in your home, that uses electricity, is used. When you use these items more, it increases the bill. For instance when the temperature outside increases during the summer, and your air conditioner has to run more to keep the house cool, your bill will increase because the air conditioner uses several kilowatts per hour. The television that you turn on each night uses kilowatts so the longer you leave it on, the more it costs on the electric bill. How you and your parent's use items that use electricity determines what kind of electric bill your parents get each month.

Lower Bills by Changing Habits:

You can do many things to lower a power bill in your home. The easiest and cheapest way is to change your habits. This means, pay attention to how you use electricity and conserve. Lowering the bill starts by turning off lights and televisions when you are leaving a room for extended periods, make sure computers go to sleep mode and turn off after non-use, and adjust the air conditioning thermostat properly. Turn off electronic devices that you do not plan to use over an extended period of time. Unplug phone chargers and other "low voltage" devices not in use.

Increase Efficiency:

As appliances age, they begin to lose efficiency, meaning that it costs more to operate them as they get older. Another way to lower your bill is to replace these old appliances with new energy efficient models. The ENERGY STAR label is a good place to start when looking for new energy efficient replacements for your old appliances. ENERGY STAR brands are proven to be much more efficient then non ENERGY STAR appliances. Always consider the efficiency of any new item you are looking at for your home.

Calculate Payback on Upgrades:

How do you tell if increasing the efficiency of an item is worth your money? Some new items may be much more efficient than what you have but the cost to purchase these items is very high. Will upgrading an item with an expensive replacement save you money in the long run? You can find this out by calculating the simple payback for the item. Let's use a 60 Watt incandescent light for example. You want to replace this light with a 15 Watt compact fluorescent (CFL) bulb because you believe it will save money. The light would be run 5 hours per day every day of the year. The incandescent bulb would use 109.5 kWh/ year ((60 Watts x 5 hrs x 365 days)/1000), the CFL will use 27.4 kWh/year. At $.12 per kWh, the incandescent would cost $13.14 to operate, while the CFL would use $3.28 which is an annual savings of $9.86. If the CFL only costs $2.00 then the payback would be $2/$9.86 = .2 years. This is a very economical upgrade.