ENERGY, ENVIRONMENT, ECONOMY, AND INNOVATION.

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THE ENERGY UNIT

OVERVIEW/OBJECTIVES:

This unit was designed for AP chemistry students who are familiar with college level chemistry and math. This unit was designed to comprise the remainder of the school year after the May AP examination. The presentation portion of this project will serve as the second semester final exam.

Due to the intense nature of AP curriculum, many of the core curricular concepts were often presented in a teacher-focused lecture format. Recognizing the cognitive benefits of student centered self-discovery, this concluding unit was designed in a way that would encourage the students to develop their own personalized curricula while developing presentations.

This unit will address present and future global energy needs (PLAN A). The students will be presented with methods of traditional power generation and transmission. They will identify some of the shortcomings and benefits inherent in these traditional sources. The students will research alternatives to these traditional sources with an emphasis on mitigating the environmental degradation that accompanies all power generation and transmission while maintaining the benefits.

In addition to alternative energy topics, students are encouraged to investigate home-grown forms of fuel that can reduce the importation of fossil fuels. The relationship to cars and other means of personalized transportation forms are indeed very American. Sources of renewable fuel and alternate forms of generation that can be used in automobiles are of great interest. If these researched technologies can be applied to, or used to replace some of the traditional sources of technology used in Michigan's struggling economy it would be very welcome.

If students are less interested in energy topics or somewhat opposed to the concept that humans can have an effect on the environment (gasp!) - another approach has been added for them. This second option (PLAN B) will address chemistry discoveries in material science, design, product formation, engineering, etc.

The summary of student research will be presented in small group presentations with an emphasis on *realistic* application and implementation. The projects should reveal environmentally and economically sound planning and design. The concept of cost-benefit analysis will be presented and applied to these alternatives, while juxtaposed with traditional sources. Persuasive and informational speech techniques will be utilized to enhance the presentation of the material. Students are encouraged to use their group members collaboratively while incorporating technology into their projects. This unit will also serve to build interest for next years physics course. The design elements of physics will serve to enhance this projects realistic application.

PROJECT SUMMATION:

The student teams of three to four members will demonstrate their understanding of their chosen topic via a presentation, complete with visual aids. Grading rubrics and time lines will follow.

Presentation Times:

3 person groups = 13-16 min, 4 person groups = 15-19 min, 5 person groups = 17- 22 min

STANDARDS:

Any and all chemistry topics learned this year are encouraged. Particularly, when enthalpies of reaction are discussed (PLAN A), the true currencies of the fuel sources are revealed. An application of chemical composition, structure, bonds, ligands, properties, etc. should accompany (PLAN B).

ALTERNATIVE ENERGY DISCUSSIONS (plan A)

I. TRADITIONAL POWER

A. COAL
   i. Where does it come from?
   ii. How is it harvested?

B. OIL
   i. Where does it come from?
   ii. How is it harvested?

C. NATURAL GAS
   i. Where does it come from?
   ii. How is it harvested/synthesized? To frack or not to frack.

D. GENERATION
   i. turbines/three phase
   ii. magnetic induction

E. TRANSMISSION
   i. DC vs AC
   ii. Transformers (step up and down)
   iii. Raw materials and moving power
   iv. Computer management/Communication among municipalities
   v. By-passing the grid (sell back)

II. COMPARING TRADITIONAL POWER TO THE ALTERNATIVES

A. Why use alternative energy/traditional methods? Obstacles
   i. Cost/Comparisons
   ii. Money; (kilowatt, megawatt), $ consumer, $ to build, $ to maintain, land costs
   iii. Environmental; resources used, wildlife affected, habitat impact, CO_2 emission, toxicity, visual
   iv. Production; Annual, seasonal, daily? Peak production?

III. ALTERNATIVE ENERGY VARIETIES

A. SOLAR
   i. Passive. building materials/design for thermal mass and water heating
   ii. Heat pumps for cooling and heating
   iii. Lens farms and heating water for turbines
   iv. Photovoltaic (technology, companies, design, future)
   v. DC to AC and linking to the grid

B. WIND
   i. turbine designs, requirements, geography
   ii. wind farms and design (computer control)
   iii. DC to AC and linking to the grid
   iv. small scale consumer turbines

C. GEOTHERMAL
   i. location, location, location
   ii. technology/design
   iii. DC to AC and linking to the grid

D. HYDRO
   i. wave; ballasts rise and fall (UK)
   ii. tidal (Eastern seaboard)
   iii. passive energy storage (falling water taking advantage of non-peak energy costs. Ludington)
   iv. dams (the mighty western mountainous regions)

v. creek. Little guys can make power too, but at what cost?
vi. DC to AC and linking to the grid

E. NUCLEAR
i. fission; plant design, reactor design, fuel/moderator (deuterium vs. graphite pellets), breeder?
ii. fusion; future, technology. Huge emphasis on reality (Do you really want to do this?)

F. HYDROGEN
i. source of electricity for electrolysis?
ii. burning H_2, safety?, practicality?, compression? Storage?
iii. fuel cells
iv. fertilizer production with atmospheric nitrogen (Born-Haber without the oil!)
v. Is this a viable topic?

III. CONSERVATION

A. USE LESS (Amory Lovins and Soft Energy Paths)
i. CARS. efficiency, hybrids, electric, air cars, ethanol (Born-Haber ammonia, it'll cost ya'), hydrogen fuel cell, silicon based tires, building materials (ever heard of graphite/carbon fiber?), changing infra-structure here in MI, car pool, mass transit, Hemlock Industries.
ii. INSULATION. super-insulated homes (don't forget the return air!), natural building materials (straw, wood), recycled products (plastic filler), modern block (cement with plastic bead filler), passive solar, e-glass, thermal mass. Are we even making progress or are we going backwards?
iii. HEATING SOURCES. electric (stream generation, wind), natural gas, oil, coal, smart thermostats, solar for hot water heaters, simple attic ventilation, geothermal heat pumps.
iv. Appliances; stereos, TV, refrigerator/freezer, microwave, computers, furnace, hot water heaters. Design, design, design
v. Recycling; material cost (in resources and energy of production).

IV. LEGISLATION AS A MITIGATING FACTOR

A. Taxing pollution
B. Pollution credits and the trading/selling of pollution commodities
C. International/Regional protocols and planning for growth (Kyoto/Copenhagen)
D. Tax incentives/research $ for alternatives (Hemlock Industries)/conservation
E. Education and training
F. Restrictions on consumer products/packaging that are wasteful or inefficient
[expand bottle bill to apply to many other products (e.g. wine/liquor/water bottles, computers, batteries, cars, appliances)
G. Building a green economy.
H. EcoParks

V. MISCELLANEOUS

A. What will green engineers do?
B. What will (should) the U.S. look like in 2050?
C. What will (should) the world look like in 2050?
D. Does the periodic table have something unique to offer on the nano scale?
E. How would you affix a photovoltaic cell to a robot?
F. What will a refrigerator look like in 2050?
G. What will a car look like in 2050?
H. What will a home look like in 2050?
I. How can catalysts be incorporated into concrete and other materials to reduce pollution?
J. What will the political landscape offer in terms of green politics, thoughtful planning in the future? [e.g. how will our needs/demands shift our political focus?]
K. Has anyone even thought of the water?

L. Are you feeling like being a resident of the Great Lakes basin has clued you in to the importance of the region and it's economy? (fresh water, large population, auto industry (1:10 U.S. jobs), a relatively open and pragmatic populace).

Materials, innovation, integration (PLAN B)

I. materials

A. THEMES

a. *physical*

i. alloys
ii. metal coatings
iii. steel hardening/forging
iv. computer chips
v. super/semi conductors
vi. packaging materials/hazardous waste containers
vii. plastics
viii. insulation
ix. building materials
x. ceramics
xi. synthetic diamonds
xii. green solvents
xiii. green paint/coatings
xiv. plasma
xv. supercritical fluids
xvi. magnetic super fluids
xvii. catalysts/catalytic converters
xviii. nanotechnology
xix. textiles, bio-foam cushions, biodegradable carpet

b. *Biomedical/food science/atmospheric*

i. artificial joints/organs/valves
ii. artificial fats
iii. ways to make vitamins more soluble/biologically available
iv. artificial osmotic membranes
v. artificial blood
vi. stem cells
vii. chemotherapy
viii. immuno-engineering to fight cancer/disease
ix. food packaging and aseptic techniques
x. atmospheric chemistry

a. pollution
b. ozone
c. aurora borealis/australis
d. green refrigerants/propellants

Cost/Benefit Analysis

Evaluating Quantitatively Whether to Follow a Course of Action

Example provided by: Mind Tools, http://www.mindtools.com/pages/article/newTED_08.htm

You may have been intensely creative in generating solutions to a problem, and rigorous in your selection of the best one available. However, this solution may still not be worth implementing, as you may invest a lot of time and money in solving a problem that is not worthy of this effort, or perhaps it creates additional problems.

Cost Benefit Analysis or CBA is a relatively simple and widely used technique for deciding whether to make a change. As its name suggests, you simply add up the value of the benefits of a course of action, and subtract the costs associated with it. In terms of resources, these associated costs are rather difficult to determine.*

Costs are either one-off, or may be ongoing. Benefits are most often received over time. One builds this effect of time into the analysis by calculating a payback period. This is the time it takes for the benefits of a change to repay its costs. Many companies look for payback on projects over a specified period of time e.g. three years. Or in terms of the environment, time required to mitigate pollution to a level of X. This would be an additional great application for compounded interest, rates, calculus, etc.

How to Use the Tool:

In its simple form, cost-benefit analysis is carried out using only financial costs and financial benefits. For example, a simple cost benefit ratio for a road scheme would measure the cost of building the road, and subtract this from the economic benefit of improving transport links. It would not measure either the cost of environmental damage or the benefit of quicker and easier travel to work.

A more sophisticated approach to building a cost benefit model is to try to put a financial value on intangible costs and benefits. This can be highly subjective. For example, is a geologically established water meadow that supports native species worth $25,000, or is it worth $500,000 - $5,000,000 because if its environmental importance? What is the value of stress-free travel to work in the morning? * There are presently many think tanks, such as the University of California at Davis, and the Cambridge Institute, that are addressing these formally intangible resources. These are all questions that people have to answer, and answers that people have to defend.

The version of the cost benefit approach explained here is a necessarily simple one. Where large sums of money are involved (for example, in financial market transactions), project evaluation can become an extremely complex and sophisticated art. For all things financial, Principals of Corporate Finance by Richard Brealey and Stewart Myers serves as something of a 'bible' on the subject.

Example:

A sales director is deciding whether to implement a new computer-based contact management and sales processing system. The department has only a few computers, and all salespeople are not computer literate. The company is aware that computerized sales forces are able to contact more customers and give a higher quality of reliability and service to those customers. They are more able to meet commitments, and can work more efficiently with fulfillment and delivery staff.

A sample cost/benefit analysis is shown below:

Costs:

New computer equipment:

10 network-ready PCs with supporting software @ $1,225 each
1 server @ $1,750
3 printers @ $600 each
Cabling & Installation @ $2,300
Sales Support Software @ $7,500
Training costs:

Computer introduction - 8 people @ $ 200 each
Keyboard skills - 8 people @ $ 200 each
Sales Support System - 12 people @ $350 each

Other costs:

Lost time: 40 people days @ $ 100 / day
Lost sales through disruption: estimate: $10,000
Lost sales through inefficiency during first months: estimate: $10,000
Total cost: $57,000

Benefits:

Tripling of mail shot capacity: estimate: $20,000 / year
Ability to sustain telesales campaigns: estimate: $10,000 / year
Improved efficiency and reliability of follow-up: estimate: $25,000 / year
Improved customer service and retention: estimate: $15,000 / year
Improved accuracy of customer information: estimate: $5,000 / year
More ability to manage sales effort: $15,000 / year
Total Benefit: $90,000/year

Payback time: $57,000 / $90,000 = 0.63 of a year = approx. 8 months

Tip: The payback time is often known as the break-even point. Sometimes this is more important than the overall benefit a project can deliver, for example because the organization has had to borrow to fund a new piece of machinery. The break even point can be found graphically by plotting costs and income on a graph of output quantity against $. Break even occurs at the point the two lines cross.

Inevitably the estimates of the benefit given by the new system are quite subjective. Despite this, the Sales Director is very likely to introduce it, given the short payback time.

General Speech Guidelines Created by Jim Julius last modified 10/15/02

Determine Your Purpose For Speaking:

Is it to inform your audience? Example: To inform my audience how to limit consumption of non-recyclable packaging.

Or is it to persuade your audience? Example: To persuade my audience to support a particular alternative source of energy.

- ***In the case of this AP Chemistry project, the speech should certainly be informative and persuasive.***

Organizational Guidelines:

- Be organized with an introduction, conclusion, and transitions.
- Know your material so that you use YOUR WORDS and maintain eye contact with audience.
- In your research/preparation for your speech, these questions may help guide you:
  What is it? (Be sure to have a clear explanation of what you are talking about)
  What makes it interesting and/or important to study?
  How does it relate to something we already understand?
  (things we have studied, things most people already know)?
- Organize your information into 2-5 main points.
- Many speakers organize their speeches around three main points.
- Use note cards, a piece of paper, flip chart, or multimedia presentation with key words to remind you of your important points. Don't read a speech that you've written out word for word, unless it's a special kind of speech that requires precision. (Not the one we're doing!)

Introduction ideas

Start by getting them interested:

- Share an interesting or unusual fact
- Ask a question
- Give an interesting quotation (something someone else said about your topic)
- Introduce some sort of visual aid
- Then let them know your topic and the main points that you will cover.

Body ideas

Each main point should have two or more supporting ideas.
Begin each main topic with some sort of transition word or words (examples: First, To begin with; next, another important idea is; finally, lastly, last but not least).
Pauses between main points also help to show that you are making a transition.

Conclusion ideas

When you come to the end of your last main point, don't just stop there. You need to wrap up your speech. Remind the audience of the important points you've made, and then conclude in a strong way such as:

- leaving them with something important or interesting that you want them to remember
- telling what you personally have enjoyed about your topic
- thanking the audience for listening, and giving them ideas to follow up if they want to learn more or take action in some way. Avoid, clichés, smarmy anecdotes, and cheesy conclusions.

Guidelines for Visual Aids:

- Make sure *all* words and pictures can be read/seen by *all* members of the audience. Choose fonts and sizes that are appropriate. Choose back-ground colors and images that do not conflict with the message.
- Do not include too much information per screen or poster, etc. Keep the messages simple. If many messages are needed, make many slides.

ENERGY PROJECT GRADING RUBRIC (127 POINTS TOTAL)

Remember, the purpose of this project is to educate the audience (as well as yourselves) about the environmental/planning issues related to power generation/transmission and consumption (PLAN A). **OR** it must serve to discuss new materials or applications of materials in new innovative ways (PLAN B). You must ***realistically*** address these issues in your presentation while providing the facts behind your decisions. You must also provide sources for this information regarding the numbers and statistics you refer to in your presentation.

You must address one of the following as a central theme to your project:
(PLANA)

- **An alternative source of power generation**
- **A method of conservation that lessens the need for the generation of power.**
- **A policy or regulatory plan that would allow for conservation/growth or self-reliance**
- **A specific application of energy technology and its effects**

(PLAN B)

- **New materials and their applications to society**
- **New innovative uses for current materials via design**

You must address *all* of the following tenants:

- **State the $ cost of your plan in relation to traditional sources**
- **Outline the environmental impacts of your plan in relation to traditional sources. If applicable describe the cost/benefit analysis of your project. Is there a break-even point?**
- **Provide a realistic application for your idea. Where will resistance to your idea come from? How will you overcome this resistance? Who are your allies?**
- **Describe in college level science detail - how it works!**
- **How much does it save, reduce, allow growth for, etc?**

PARTICIPATION (17 points) One point per day. Students must be present to earn participation points. Absolutely no exceptions! Being tardy will lose 0.25 pt/day. T-10 will lose 0.5 pt/day. Unexcused absences are a loss of 1.0 pt/day. If you are off task, messing with your phone, doing other schoolwork, on Facebook, Snapchat, etc. you will receive no credit!

PREPARATION (30 points)
[These check-ins will count as a portion of your final exam.]
There will be two, 15 point, check-ins scheduled with each group prior to the actual presentations. These will serve to monitor group member's contributions as well as to provide feedback for the project as a whole.

Check-In Rubric Energy Project AP Chemistry

Group check-in #1 [15 points]

Check-ins can be presented in google docs or by showing a Powerpoint/Keynote file.

- 15 points. All group members were present (or examples of their contributions were evident). There was a detailed mass of information arranged and a preliminary outline of the material was available for viewing. Outlines will include Roman Numerals, letters, etc. Power point presentations/visual aids were underway in terms of bulk headings/skeletal design. Scripts and orders of the presentation were in the early planning phase. Each student is aware of the information they will be responsible for and their approximate time responsibilities.
- 13 points. 2 point deductions for **any** of the following: all group members work was not evident, lots of information was available, but still very little planning towards the overall presentation (in terms of outline, order, visual aids, etc.). All group members are not aware of their role/speaking order/times.
- 11 points. 4 point deductions for **any** of the following: only the work of half or less of the group is available, random piles of info is available with little regard for organization/implementation, lack of presentation planning is evident (no hierarchy of presenting/visual aids have been constructed). Present scope of the presentation is much too broad and diffuse.

Group check-in #2 [15 points]

- 15 points. All group members were present (or examples of their contributions were evident). There is a very specific and highly ordered mass of information arranged according to each student's contribution and role in the presentation. A strict and orderly outline of the material was available for viewing. Power point presentations/visual aids are fully underway in terms of final outline, headings, phrasing, pictures, etc. (or bring a flash drive or pictures to support your progress). Scripts (what you will say – verbatim) and orders of the presentation are established. Detailed timing predictions are made for each segment of the presentation. Each student is *fully* aware of the information they will be responsible for, as well as the method of delivery. The best way to provide all of this information at once is to come to the check-in with the following items: Powerpoint presentation with slides. Include your script in the notes section of your slides. This way I can really get a feel for your slide layout and exactly what information will be presented.
- 13 points. 2 point deductions for **any** of the following: all group members work was not evident, lots of information was available, but still a lack of planning towards the overall presentation (in terms of outline, order, visual aids, etc.). All group members are not aware of their role.
- 11 points. 4 point deductions for **any** of the following: only the work of half or less of the group is available, a lot of info is available, but there is a less than detailed plan for the implementation of this material, lack of presentation planning is evident (hierarchy of presenting/visual aids have been constructed, but there is no script or power point, etc. to represent progress). Present scope of the presentation is still a bit too broad to represent the time limitations.

PRESENTATION (80 points)

All group members were prepared and materials well organized. [15 points]

* 3 person groups = 13-16 min, 4 person groups = 15-19 min, 5 person groups = 17- 22 min

- 15 pts. A well-oiled machine! The transition was smooth and seamless. Materials were together at the start and completion of the presentation. Words came off as if they were rehearsed. Problems were anticipated and the proper adjustments made (technological issues/someone comes to the door/members of the audience are distracting or talking).
  The presentation was within the appropriate time frame for the group size.

- 13 points. Two point deduction for **any** of the following: transition, rehearsal, materials, anticipation problems, timing issues. Examples: when you transitioned from your intro to the body of the presentation, your group members turned and walked into each other, displaying a lack of choreography. You started your PowerPoint without a screen with which to display it. Your group was within one minute short or over the time limit.

- 11 points. Four point deduction for **any** of the following: transition, rehearsal, materials, anticipation problems, timing issues. Example: when presenting, group members talked over each other revealing a lack of a script (or adherence to one). You were between one and two minutes over or under the desired time limits

- 9 points. Six point deduction for major lack of planning. Group members look at each other to find out who should be talking. Long, awkward pauses, etc. Timing off by over two minutes.

All group members are participating *equally* in this presentation. [15 points]

- 15 points. Self-explanatory.

- 13 points. Uneven representation (slight). Ex: two of the three group members seemed to do more than the third.

- 11 points. Uneven representation (moderate) Ex: two of the three group members seemed to do the majority of the work. The third/fourth members lack of commitment was evident.

- 8 points. Uneven representation (severe) Ex: someone obviously dominated the presentation.

The science of the presentation is explained clearly and concisely. [25 points]

- 25 points. Awesome job! Great information is delivered. Enunciation is clear and crisp (if you are writing on the board you are not talking into the board). Speaking volume is appropriate. Visual aids are clearly seen, accurate, and legible. Your group made the audience perk up – nice explanation! They became interested in the **AP level science** that was presented. You explained exactly HOW the concept works.

- 21 points. 4 points deducted for **any** of the following slight issues: enunciation/volume, visual aid not very clear, science topics not addressed at a college level.

- 19 points. 6 points deducted for **any** of the following moderate/severe issues: enunciation/volume, visual aid not clear/appropriate (an ongoing problem), science topics not thoroughly addressed/incorrect information, lack of depth.

- 15 points. 10 points deducted. Science sadly neglected. The content/application is left up to the audience's imagination.

The audience is engaged. [5 points]

- 5 points. Yes! (nice greeting, questions asked, members used as props, etc)

- 3 points. Kind of . . . you had them at the beginning and end but lost them in the middle

- 1 point. No! Lots of day dreaming!

Overall Presentation Grade. [10 points]

Overall aesthetic feeling of the presentation.

A presentation can be technically well-done, but boring and lackluster.

10 points =A+, 9 points = A, 8 points = B, 7 points = C, 6 points = D, Below 6 = Double OUCH!

Works Cited [10 points]

All citations require MLA format

References should be delivered in the following ***two*** **forms.** These references must be supplied **prior** to the start of the presentation.

- HARD COPY: References listed as a printed document with the following two headings**:
- DIGITAL: A digital copy must also be uploaded to Mr. Collins' computer.

****HEADINGS:**

1. **Information/Facts-**
2. **Images/Graphics/Video-**

[Items in these two headings should be in chronological order with respect to the presentation! After a reference, a brief description of the use should follow including a description and number of the slide.]

10 points. All information is properly cited in MLA according to the two heading format. Information matches the chronological flow of the presentation. Two forms (digital/hard copy) were included prior to the presentation. **All** web links in the e-version **are active**. This means when I click on them I will be taken to your e-sources!

DEDUCTIONS.
-5 points . Lacking one of the forms (digital or hard copy).
-4 points. References not in MLA.
-4 points. References do not follow chronology of presentation.
-4 points. References are not properly described
(e.g. I can't tell which information/image corresponds with which citation or slide #).
-2.5 points. References are not provided prior to the presentation. (-2.5 **per** citation form).
-2.5 points. Web links in the e-version of the references are not active.

Group Participation Survey

The following information will be used to tally final presentation grades. [e.g. if your group agrees that you slacked-off, your points can be awarded to the person (people) who completed most of the work.] Each student will fill-out this form.
It will be kept confidential.

Group Members	% Participation
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

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