Kenneth O’Rourke
Energy Unit

Energy, energy everywhere, but not a drop to spare

Unit Description

This lesson was designed using the backwards design model illustrated by Wiggins and McTighe (1998) and influenced by the enduring understandings noted below. It covers the topic of alternative energy generation. The unit is prefaced by a more mechanical treatment of energy in the previous lesson. The previous lesson focused on potential and kinetic mechanical energy, energy transformations between them, efficiency of energy transformations, and the law of conservation of energy. This lesson focuses on higher order thinking skills that incorporate the concepts learned in the previous lesson and apply them to the energy crisis facing the world today. Students need to use their previous knowledge of energy and incorporate it with alternative energy sources. Students must then use this knowledge to apply it to current problems in society today, and propose possible solutions. Students will need to analyze and synthesize new and previous learning to be successful. Students that make a concrete connection between how the mechanical energy is transformed from or into other forms of energy and then into something we can use will leave the lesson an informed citizen able to make intelligent decisions regarding alternative energy in our democratic society.

Student misconceptions (alternate frameworks)

Student misconceptions in science many times occur when an abstract concept is thought to have concrete properties. This is natural for students to call on their personal experience with objects and to base their understanding on how they perceive those objects to behave (Reiner, Slotta et al). The problem also occurs when scientific language and colloquial language have different meanings, such as the everyday meaning of theory as an idea to the scientific concept of theory. Research has shown that students come to school holding powerful conceptions with explanatory power, but those concepts were inconsistent with scientific concepts presented in school (Smith, diSissa, Roschelle). A common conceptual misconception would be that heavy things fall faster than light things. While this is true when air resistance becomes significant, it is not an accurate description of nature. In many cases, I myself have observed these principles as the biggest roadblocks to students' understanding of science. In teaching energy some of the most powerful misconceptions or alternative understandings of energy are: (Clement J. 1987)

- Energy and force are interchangeable terms
- Things use up energy
- Energy is not conserved because we are running out of it
- An object at rest has no energy
- Energy is a thing
- Energy is only associated with movement
- Energy is a fuel
- Energy is recycled

Students that have difficulties in breaking away from vernacular language to using a more scientific language tend to retard the students' understanding in science (Jones, Idol). I have found this to be the case in teaching energy. Students routinely think that energy, force, momentum, and power, all have the same meaning. While students that make the distinction usually do much better than students that do not, it is important to try and insure that all students are brought to the point of understanding the terms unique scientific meaning. Accentuating the differences and making distinctions in compare and contrast questions is an effective way to bring students to a proficient understanding of their scientific meaning. Students come to school with a very powerful preconceived notion of how the world works. When they are confronted with an anomalous situation, they will often ignore the anomaly, force it to fit their understanding, or think that they made a mistake in a lab situation. The successful student will change their model to incorporate the anomaly. While many students become successful by the time the unit assessment is completed, many will not retain this changed model into their permanent thinking and will revert back to their previous model (Chong L. 2005) I have seen this in action myself. Many times I have extinguished the idea that heavy objects fall faster than light objects in the absence of friction, only to have students explain the opposite to me within a week of the assessment. An effective method is to constantly revisit those concepts whenever applicable. For example: when discussing potential energy and kinetic energy revisit the concepts of acceleration under gravity and make predictions as to the effects of energy because of the uniform acceleration of all objects on Earth. When getting to a more complex concept such as energy, previous misconceptions that were thought to have been extinguished surface again. By using the new topic of energy the concept of uniform acceleration under gravity can be revisited and the correct concept reinforced. Students misconceptions through erroneously attributing concrete principles to abstract concepts, and the misinterpretation of scientific meanings of words, makes it very challenging to reach many students. A good way to intercept those problems is to identify them early. One effective method for identifying misconceptions early is the administering of a pretest. After a student's misconception has been identified, and as students work in small groups, I will target those students and attempt to guide them to a more complete understanding. The final assessment will show what students were successful in incorporating the new knowledge and amending their previous framework to get to a more complete understanding of the concept.

Backwards Design Stage one: Identifying desired results

This unit is part of the ninth grade curriculum at Pennfield Middle School. The learning objectives have been shaped through the Pennsylvania. state standards, the North Penn School District's ninth grade science curriculum, the lesson's enduring understandings, and the lesson's essential questions. The unit is comprised of approximately fifteen class periods lasting 40 minutes each. The assessments are largely a presentation of students' analysis of information, making a decision based on that analysis, and defending their analysis through their mastery of the concepts of energy conservation, energy transformation, the influence of non-conservative forces, and the ability to quantify their argument through mathematics. In order to begin this unit, students must possess previous knowledge in these areas:

- ✓ Define and calculate speed and velocity
- ✓ Define and calculate acceleration
- ✓ Newton's Laws of Motion
- ✓ Define and calculate force
- ✓ Define and calculate momentum
- ✓ Define work and solve problems using work
- ✓ Define and solve problems using mechanical advantage
- ✓ Define Energy
- ✓ Calculate kinetic and potential energy problems
- ✓ Define and describe the principle of the conservation of energy

Enduring understandings, Essential questions, Learning outcomes

EU #1: Scientific knowledge is continually, although not steadily increasing and changing through the results of experiments and the bridges built between experimental observations and underlying concepts and theories.

Q #1: Is nuclear energy a viable energy option?

LO #

1) Students will describe nuclear fusion and nuclear fission
2) Students will compare and contrast nuclear fission and fusion
3) Students will discuss the pros and cons of nuclear fission power generation
4) Students will discuss the problems with designing nuclear fusion reactors

EU #2: Examples of all levels and areas of science are found in daily life and in modern human development.

Q #2: In what ways will alternative energy generation impact the planet?

LO #

5) Students will discuss the importance of alternative fuel sources
6) Students will describe the benefits and disadvantages of solar, wind, tidal, and geothermal energy

EU #3: There are core concepts and processes in science that transcend the arbitrary boundaries between traditional disciplines.

Q #3: How is energy described in physics, chemistry, & biology, and how are they related?

LO #

7) Students will describe how energy is transformed from one form to another within and without systems
8) Students will describe how energy leaves a system during an energy transformation through non-conservative forces (friction, heat)
9) Students will explain the implausibility of a perpetual motion machine through the Law of Conservation of Energy

Standards

3.1. Unifying Themes

3.1.10. **GRADE 10**

A. Describe concepts of models as a way to predict and understand science and technology.

- Apply mathematical models to science and technology. **(EU #3, Q #3, LO 7, 8, 9)**

B. Describe patterns of change in nature, physical and man made systems.

- Describe how fundamental science and technology concepts are used to solve practical problems **(EU #2, Q #2, LO 5 & 6)**
- Recognize that stable systems often involve underlying dynamic changes

(EU #3, Q #3, LO 7, 8)

3.2. Inquiry and Design

3.2.10. **GRADE 10**

A. Apply knowledge and understanding about the nature of scientific and technological knowledge.

- Integrate new information into existing theories and explain implied results.

(EU #1, Q #1, LO 1, 2, 3, 4)

B. Apply process knowledge and organize scientific and technological phenomena in varied ways.

- Develop appropriate scientific experiments: raising questions, formulating hypotheses, testing, controlled experiments, recognizing variables, manipulating variables, interpreting data, and producing solutions.

(EU #1, Q #1, LO 1, 2, 3, 4)

- Use process skills to make inferences and predictions using collected information and to communicate, using space / time relationships, defining operationally.

(EU #2, Q #2, LO 5 & 6)

C. Apply the elements of scientific inquiry to solve problems.

- Generate questions about objects, organisms and/or events that can be answered through scientific investigations. **(EU #1, Q #1, LO 1, 2, 3, 4)**
- Evaluate the appropriateness of questions. **(EU #1, Q #1, LO 1, 2, 3, 4)**
- Conduct a multiple step experiment. **(EU #2, Q #2, LO 5 & 6)**
- Suggest additional steps that might be done experimentally.

(EU #1, Q #1, LO 1, 2, 3, 4)

D. Identify and apply the technological design process to solve problems.

- Examine the problem, rank all necessary information and all questions that must be answered. **(EU #1, Q #1, LO 1, 2, 3, 4)**
- Propose and analyze a solution.

(EU #1, Q #1, LO 1, 2, 3, 4) (EU #2, Q #2, LO 5 & 6)

- Communicate the process and evaluate and present the impacts of the solution.

(EU #2, Q #2, LO 5 & 6)

3.4 Physical Science, Chemistry and Physics

3.4.10. **GRADE 10**

B. Analyze energy sources and transfers of heat.

- Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).

(EU #2, Q #2, LO 5 & 6)

Unit Objectives

- Students will discuss the importance of alternative fuel sources
- Students will describe the benefits and disadvantages of solar, wind, tidal, and geothermal energy
- Students will describe how energy is transformed from one form to another within systems
- Students will describe how energy leaves a system during an energy transformation through non-conservative forces (friction, heat)
- Students will describe nuclear fusion and nuclear fission
- Students will compare and contrast nuclear fission and fusion
- Students will discuss the pros and cons of nuclear fission power generation
- Students will discuss the problems with designing nuclear fusion reactors

Backwards design stage two: Assessment evidence

Assessment activity 3:

1) Goal: Students to examine how wind power generation works, and to ascertain its feasibility in their area.
2) Role: The students act as an engineer designing and testing different materials and shapes in order to build the most efficient and durable wind generator.
3) Audience: Teacher and peers
4) Situation: Students are given basic plans for a wind generator. The generator and base is the same for all engineering groups. The students are to draw on previously learned material to plan their design. The students must test the types of materials,

and how to shape those materials to make the best generator. Students then write a critical analysis of their design and offer ways to improve their design. The group's generator that delivers the most current over 3 minutes gets a 5 point bonus on the assessment 7.

5) Product: A working wind generator, and critical analysis. Worth 8% of the grade for the unit.
6) Standards:
   a) Wind generator graded on output efficiency. 75% to 100% is 20 points, 50% to 74% is 15 points, 25% to 49% is 10 points, 1% to 24 % is 5 points, and 0% is 0 points.
   b) Critical analysis needs to explain sources of error, and ways to improve performance.

Assessment activity 4:

1) Goal: For students to get an appreciation for the amount of energy found in the tides. For students to examine what types of energy production are feasible in their local area.
2) Role: Student as a concerned citizen
3) Audience: Teacher and peers
4) Situation: Teacher short lecture on tidal generation. Teacher guided discussion of tidal generation. Students write individual opinions on the effects of tidal power in PA, and write a convincing letter to environmental groups in New Jersey to get them to pressure the New Jersey State government for the implementation of tidal power plants.
5) Product: The opinion piece on tidal power in PA (Delaware bay, and Lake Erie are only 2 possible places), and the letter to the environmental groups in New Jersey. Worth 8% of the grade for the unit.
6) Standards:
   a) Opinion piece should detail areas that tidal power in PA is viable, possible ways it could be implemented, and why it should or should not be implemented.

b) Letter needs to list advantages of tidal power in a coherent way to convince the environmental groups to support tidal generation in New Jersey. (Letter should detail benefits to environment and how negative effects could be mitigated.

Backwards Design stage Three: The Learning Plan

<u>Where</u>: At the beginning of each lesson students are given a list of topics that are covered in the unit. At the beginning of every class the class objectives with learning outcomes are posted on the board, and gone over.

Unit Pacing
Lessons 1 through 4 address Eu # 2, EQ #2 and LO # 10 & 11

EU #2: Examples of all levels and areas of science are found in daily life and in modern human developments

Q #2: In what ways will alternative energy generation impact life at the local through global level?

LO #

10) Students will discuss the importance of alternative fuel sources
11) Students will describe the benefits and disadvantages of solar, wind, and tidal

Lesson 1

Do we need alternative fuel sources?

<u>Hook:</u> Students brainstorm in small groups reasons that we need fuel sources other than fossil fuels.

<u>Experience:</u> Develop a class list of the reasons for alternative fuel sources. Students read the E-zine article on why alternative fuels are needed. Students then compare their list to the article, and decide to add or delete to the master list. Students then make proposals for the county government to implement energy policy. Students must give logical reasoning for the policies.

Resource: E-zine article: http://ezinearticles.com/?Alternative-Energy---Why-do-we-Need-it?&id=801280

Reflection: Students are asked to reflect on alternative energies and discuss their ideas and feelings on them in a large group discussion at the end of class.

Lesson 2

Solar Power

Hook: Today we are going to cook something in a pizza box using the sun as our energy source.

Experience: Students perform a solar cooking lab. Students construct their group's solar oven in the first class period. The following class period students cook a muffin or something they bring from home based upon teacher's approval. During cooking students read about solar energy and answer question about them.

Resources: Pizza box solar oven instruction:
http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/other/solar.html
Solar energy information and quiz adapted from:
http://www.darvill.clara.net/altenerg/solar.htm

Reflection: Students are asked to describe the experience and relate it to their own lives.

Lesson 3

Wind Power

Hook: Who can build the best wind generator? Each lab group is a design team. The team that designs the best wind generator gets a 5 point bonus added to the final assessment.

Experience: Lab groups are given kits to build their own wind generator. The students will then decide on what materials and shape to make the wind turbine. If students use light weak materials, it will spin faster and be more efficient, but it will be less dependable and prone to breaking. If students use the heavy most durable parts, it will have poor efficiency, but better dependability. Students then write a critical analysis of their design and offer ways to improve their design.

Resources: Instructions for building the turbine http://www.re-energy.ca/pdf/wind-turbine.pdf

Reflection: Students are asked why wind power is not used more if it is easy enough for a kid to do it.

Lesson 4

Tidal Power

Hook: How many gallons of water can you lift? How much energy does it take to move an ocean? What if we used that energy to generate electricity?

Experience: Students discuss the advantages and disadvantages of generating tidal power. Students also discuss the possible environmental effects of Tidal energy. Students assess if tidal energy would have an impact on electricity generated in PA and develop a proposal to build a tidal power station in New Jersey.

Resources: Tidal generation information: http://www.darvill.clara.net/altenerg/tidal.htm

Reflection: Students are asked to reflect on could all the Earth's energy needs be met if all of the power held in the tides is converted into usable energy.

Lesson 5 (Fully developed lesson)

Nuclear Power

EU #1: Scientific knowledge is continually, although not steadily increasing and changing through the results of experiments and the bridges built between experimental observations and underlying concepts and theories

Q #1: Is nuclear energy a viable energy option?

LO #

12) Students will describe nuclear fusion and nuclear fission
13) Students will compare and contrast nuclear fission and fusion
14) Students will discuss the pros and cons of nuclear fission power generation
15) Students will discuss the problems with designing nuclear fusion reactors

Hook: We all know what nuclear bombs can do. Their destructive power is enormous. Nuclear power has become one of the most feared power sources on the planet. Is this fear justified? What are the real dangers and benefits behind nuclear Power?

Experience: Students will research nuclear power in small groups and design a PowerPoint presentation that outlines the pros and cons of nuclear power generation, and advocates a position of the building of nuclear power plants or a ban on the building of nuclear power plants, and each will individually write a persuasive essay stating why nuclear reactors should be pursued or banned.

Step one: Research nuclear processes

Students research the process of nuclear fission and nuclear fusion. Students need to explain the process and energy released by both types on nuclear power

Step two: Students research the basic method by which nuclear fission plants operate. Students research the parts of a reactor, the method of fission in the reactor, the cooling of the reactor, and the waste generated by the reactor.

Step three: Pros and cons of nuclear fission

Students research the benefits and drawbacks of nuclear fission plants. Students need to take into account economic costs and benefits, environmental costs and benefits, security or safety costs and benefits, impact of added electrical generation to the public.

Step four: Nuclear fusion

Students research methods that nuclear fusion reactors operate. Students give descriptions of reactors, the energy produced, and the waste generated by the reactor.

Step five: Pros and cons of nuclear fusion

Students research the benefits and drawbacks of nuclear fusion. Students need to take into account whether it is worth it to continue research into fusion energy, the current problems with fusion reactors, the benefits and drawbacks of helium 3 reactors and the availability of helium 3 fuel.

Step six: Students write a persuasive essay stating why nuclear reactors should be pursued or banned.

Resources: Nuclear Power project packet, computer with internet access, PowerPoint

Assessment: Project rubric for PowerPoint, student essay

Reflection: The student essay is the reflection for this activity.

Lesson 6

Energy flow through and between systems

EU #3: There are core concepts and processes in science that transcend the arbitrary boundaries between traditional disciplines.

Q #3: How is energy described in physics, chemistry, & biology, and how are they related?

LO #

16) Students will describe how energy is transformed from one form to another within and without systems
17) Students will describe how energy leaves a system during an energy transformation through non-conservative forces (friction, heat)

Hook: There is energy all around us. We are going to be detectives and determine the possible paths different forms of energy take to become electricity in your home.

Experience: Energy flow using inspiration. Students use inspiration to follow the flow of energy within and without different systems. Students are given a source of energy and must describe the different transformations it goes through to generate electricity.

Example: Energy from the sun is used by plants to generate heat and to activate a chemical reaction to form a carbohydrate and oxygen, that carbohydrate is compressed over time and becomes coal, the coal is burned releasing the energy from the sun. The activity shows students that the total amount of energy in the universe will always stay constant.

Assessment: Inspiration energy flow sheets.

Reflection: Students are asked to reflect on why energy is so misunderstood in the world, and what do they feel they do not understand about energy.

Resources:

1) Pizza box solar oven instruction: http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/other/solar.html
2) Solar energy information and quiz adapted from: http://www.darvill.clara.net/altenerg/solar.htm
3) Instructions for building the turbine http://www.re-energy.ca/pdf/wind-turbine.pdf
4) Tidal generation information: http://www.darvill.clara.net/altenerg/tidal.htm
5) The International Atomic Energy Agency (IAEA) Gives great information on nuclear rules and regulations around the world as well as explanations of fusion and fission nuclear processes: http://www.iop.org/EJ/journal/NuclFus
6) Great site for nuclear power generation lessons and explanations (Nuclear Regulatory Commission) : http://www.nrc.gov/reading-rm/basic-ref/teachers/unit3.html
7) Teacher's domain on wind power and wind power resources: http://www.teachersdomain.org/resources/psu06/energy21/sci/rotor/index.html
8) Great site for energy transformations specializing on alternative energy: http://www.nvsd44.bc.ca/sites/ReportsViewOnePopM.asp?RID=3811

Appendix:

1) Pretest
2) E-zine article: http://ezinearticles.com/?Alternative-Energy---Why-do-we-Need-it?&id=801280
3) Nuclear power project packet

Appendix 1

Pre-test

Name ______________________________

1) Are coal, oil, and natural gas considered an alternative fuel? (Explain why or why not)

____

____

____

2) What is the difference between nuclear fission and nuclear fusion?

____

____

____

3) Explain how wind power works.

____

____

4) Can energy be generated from the tides? If so, how?

5) What are the disadvantages to solar power?

6) Are alternative fuel sources needed? (Explain why or why not)

7) After energy is used, what happens to it?

8) Name an example when energy is generated without moving something.

9) Is there any difference between energy, power, and force. If so, explain them.

____

____

____

10) Is energy recycled? If so, how?

____

____

____

Appendix 2

http://ezinearticles.com/?Alternative-Energy---Why-do-we-Need-it?&id=801280

Why Do We Need Alternatives?

To answer that question, we need to start by discussing fossil fuels-what they are, where they come from, how they are used and the advantages and disadvantages of each. Within this context, the pressing need for alternatives becomes quite clear.

What are fossil fuels?

Most fossil fuels are formed from the remains of long-dead creatures and plants. Buried over the course of hundreds of millions of years, these carbon-based deposits have been converted by heat and pressure over time into such combustible substances as crude oil, coal, natural gas, oil shales and tar sands. A smaller portion of fossil fuels is the handful of other naturally occurring substances that contain carbon but do not come from organic sources.

To make more fossil fuels would require both the creation of new topsoil filled with hydrocarbons, and time-lots of time. Given estimates of current fossil fuel reserves worldwide, it's not possible we can wait out the problem, and continue our dependence on fossil fuels until new reserves are built. At current consumption rates, the reserves of oil and coal and other fossil fuels won't last hundreds of years, let alone hundreds of millions of years.

As for creating more, experts have pointed out that it can take close to five centuries to replace a single inch of topsoil as plants decay and rocks weather. Yet in the United States, at least, much of the topsoil has been disturbed by farming, leading still more experts to the disturbing conclusion that in areas once covered by prairie, the past hundred years of agriculture have caused America's "bread basket' to lose half of its topsoil as it erodes thirty times faster than it can form.

The Advantages of Fossil Fuels in Energy Production

There are many reasons why the world became dependent on fossil fuels, and continues to rely on them. For example, it has so far been relatively cost-effective in the short run to burn fossil fuels to generate electricity at strategic centralized parts of the grid and to deliver the electricity in bulk to nearby substations; these in turn deliver electricity directly to consumers. These big power plants burn gas or, less efficiently, coal. Since so much electricity can be lost over long-distance transmission, when power needs to be concentrated more in one region than another, the fuels are generally transported instead to distant power plants and burned there. Liquid fuels are particularly easy to transport.

Thus far, fossil fuels have been abundant and easily procured. Petroleum reserves worldwide are estimated at somewhere between 1 and 3.5 trillion barrels. Proven coal reserves at the end of 2005, as estimated by British, were 909,064 million tons worldwide. Coal, furthermore, is relatively cheap.

Perhaps the simplest reason why the world continues to depend on fossil fuels is that to do anything else requires change: physical, economical, and-perhaps the most difficult-psychological. The basic technology for extracting and burning fossil fuels is already in place, not only in the large power plants but at the consumer level, too. Retrofitting factories would be cost-prohibitive, but perhaps even more daunting would be replacing heating systems in every home, factory and building. Ultimately, however, the true resistance may be our nature. We humans tend to resist change in general, and in particular those changes that require us to give up longstanding traditions, alter our ways of thinking and living, and learn new information and practices after generations of being assured that everything was "fine" with the old ways.

Why Do We Need Alternatives?

If there are so many reasons to use fossil fuels, why even consider alternatives? Anyone who has paid the least bit of attention to the issue over the past few decades could probably answer that question. If nothing else, most people could come up with the first and most obvious reason: fossil fuels are not, for all practical purposes, renewable. At current rates, the world uses fossil fuels 100,000 times faster than they can form. The demand for them will far outstrip their availability in a matter of centuries-or less.

And although technology has made extracting fossil fuels easier and more cost effective in some cases than ever before, such is not always the case. As we deplete the more easily accessible oil reserves, new ones must be found and tapped into. This means locating oil rigs much farther offshore or in less accessible regions; burrowing deeper and deeper into the earth to reach coal seams or scraping off ever more layers of precious topsoil; and entering into uncertain agreements with countries and cartels with whom it may not be in our best political interests to forge such commitments.

Finally, there are human and environmental costs involved in the reliance on fossil fuels. Drilling for oil, tunneling into coalmines, transporting volatile liquids and explosive gases-all these can and have led to tragic accidents resulting in the destruction of acres of ocean, shoreline and land, killing humans as well as wildlife and plant life. Even when properly extracted and handled, fossil fuels take a toll on the atmosphere, as the combustion processes release many pollutants, including sulfur dioxide-a major component in acid rain. When another common emission, carbon dioxide, is released into the atmosphere, it contributes to the "greenhouse effect," in which the atmosphere captures and reflects back the energy radiating from the earth's surface rather than allowing it to escape back into space. Scientists agree that this has led to global warming, an incremental rise in average temperatures beyond those that could be predicted from patterns of the past. This affects everything from weather patterns to the stability of the polar ice caps.

Conclusion

Clearly, something must change. As with many complex problems, however, the solution to supplying the world's ever-growing hunger for more energy will not be as simple as abandoning all the old methods and beliefs and adopting new ones overnight. Partly this is a matter of practicality-the weaning process would take considerable investments of money, education and, most of all, time. The main reason, however, is that there is no one perfect alternative energy source. Alternative will not mean substitute.

What needs to change?

It seems simplistic to say that what really needs to change is our attitude, but in fact the basis of a sound energy plan does come down to the inescapable fact that we must change our way of thinking about the issue. In the old paradigm, we sought ways to provide massive amounts of power and distribute it to the end users, knowing that while much would be lost in the transmission, the advantages would be great as well: power plants could be located away from residential areas, fuels could be delivered to central locations, and for consumers, the obvious bonus was convenience. For the most part our only personal connection with the process would be calling the providers of heating fuel and electricity, and pulling up to the pumps at the gas station. And the only time we would think about the problem would be when prices rose noticeably, or the power went out.

There are people who have tried to convince us that there is no problem, and that those tree-hugging Chicken Littles who talk about renewable and alternative energy want us all to go back to nature. More often than not these skeptics' motivations for perpetuating this myth falls into one of two categories: one, they fear what they don't understand and are resistant to being told what to do, or two, they have some political or financial stake in enabling our fossil-fuel addiction. (And sometimes both.)

The reality is that except for altering our ways of thinking, there will not be one major change but a great many smaller ones. A comprehensive and successful energy plan will necessarily include these things:

- Supplementing the energy produced at existing power plants with alternative energy means, and converting some of those plants to operate on different "feedstock" (fuels)

- Shifting away from complete reliance on a few concentrated energy production facilities to adding many new and alternative sources, some feeding into the existing "grid" and some of supplying local or even individual needs
- Providing practical, economical and convenient ways for consumers-residences, commercial users, everyone-to adapt and adopt new technologies to provide for some or all of their own energy needs
- Learning ways in which we can use less energy now ("reduce, reuse, recycle"), using advances in technology as well as simple changes in human behavior to reduce consumption without requiring people to make major compromises or sacrifices

Alternative Energy is a crucial link in our energy future if we are to cut the oil cord. We present thoughts, ideas, info and news about alternative energy at Alternative Energy HQ. Get a free copy of our book "Cutting the Oil Cord - Using Alternative Energy in Your Life" at - http://alternativeenergyhq.com

Article Source: http://EzineArticles.com/?expert=Kevin_Rockwell

Appendix 3

Nuclear Power Project

Introduction

We all know what nuclear bombs can do. Their destructive power is enormous. Nuclear power has become one of the most feared power sources on the planet. In this project we will decide if nuclear power should be feared and what is being done to make it safer.

Basic task

Students will research nuclear power in groups of four, design a PowerPoint presentation that outlines the pros and cons of nuclear power generation, and advocates a position of the building of nuclear power plants or a ban on the building of nuclear power plants, and each will individually write a persuasive essay stating why nuclear power should be pursued or banned.

Process

Step one: Research nuclear processes

Students research the process of nuclear fission and nuclear fusion. Students need to explain the process and energy released by both types on nuclear power

Step two: Students research the basic method by which nuclear fission plants operate. Students research the parts of a reactor, the method of fission in the reactor, the cooling of the reactor, and the waste generated by the reactor.

Step three: Pros and cons of nuclear fission

Students research the benefits and drawbacks of nuclear fission plants. Students need to take into account economic costs and benefits, environmental costs and benefits, security or safety costs and benefits, impact of added electrical generation to the public.

Step four: Nuclear fusion

Students research methods that nuclear fusion reactors operate. Students give descriptions of reactors, the energy produced, and the waste generated by the reactor.

Step five: Pros and cons of nuclear fusion

Students research the benefits and drawbacks of nuclear fusion. Students need to take into account whether it is worth it to continue research into fusion energy, the current problems with fusion reactors, the benefits and drawbacks of helium 3 reactors and the availability of helium 3 fuel.

Step six: Students write a persuasive essay stating why nuclear reactors should be pursued or banned. Essay needs to have a clear pro/con nuclear power argument. You may be for one method of nuclear power and against the other. Every point made in the essay should be backed by facts presented in the PowerPoint or referenced at the end of the essay. The essay should be at least 200 words and no more than 800 words.

Assessment:

Nuclear Power Rubric

		Not Present	Poor	Proficient	Excellent
Process	Fission	0	5	11	15
	Fusion	0	5	11	15
Safety	Fission	0	4	8	10
	Fusion	0	4	8	10
Wastes	Fission	0	4	8	10
	Fusion	0	4	8	10
Cost/Benefit	Fission	0	5	11	15
	Fusion	0	5	11	15
Essay	Nuclear Energy	0	7	14	20
References	Sources of information	0	3	6	10

Total Score ____________

(Total score/130) x 100% = ____________

Process: *Not present* scores reflect no explanation of the process of nuclear reactions, *Poor* scores reflect little more than the mention of nuclear reactions with very little coherent detail on the process, *Proficient* scores reflect a coherent organized description of nuclear reactions and why/how they result in the release of energy, *Excellent* scores reflect an understanding of why/how fusion and fission only work for particular elements.

Safety: *Not present* scores reflect no mention of the safety issues for each kind of nuclear power, *Poor* scores reflect on incomplete development of topic where possible hazards and past failures are not covered effectively, *Proficient* scores reflect through listing and explanation of safety issues facing nuclear power, *Excellent* scores reflect a through listing and explanation of safety issues facing nuclear power, and ways the industry is trying to mitigate dangers.

Wastes: *Not present* scores reflect little to no mention of nuclear wastes, *Poor* scores reflect types of waste with no description of how they are processed, *Proficient* scores reflect the types of waste generated and how they are processed and stored, *Excellent* scores reflect the types of waste generated and how they are processed and stored, and detail methods for handling wastes in the future.

Cost/Benefit: *Not present* scores reflect no attention to the cost/benefit breakdown of nuclear power, *Poor* scores reflect little thought or research into nuclear power, *Proficient* scores reflect a logical breakdown of the benefits and drawbacks (economic, environmental)to nuclear power, *Excellent* scores reflect a logical breakdown of the benefits and drawbacks (economic, environmental)to nuclear power, and include a reasoned approach to whether either form of nuclear power should be utilized to meet the energy needs now and in the future.

Essay: This is the individual section of the essay. This is where you show your understanding of nuclear power and is independent of group work. *Not present* scores reflect not submitting an essay, *Poor* scores reflect little coherent knowledge of nuclear processes and the debate on the future of nuclear energy, *Proficient* scores reflect coherent knowledge of nuclear processes and the debate on the future of nuclear energy, *Excellent* scores reflect clear understanding of nuclear processes and a command of the issues facing nuclear power today.

References: *Not present* reflects no references provided, *Poor* reflects 1- 3 references provided, *Proficient* reflects 4-6 references provided, *Excellent* reflects more than 6 references in MLA format

References

Wiggins, g., McTighe, J. (2005) *Understanding by design*, New York: Prentice Hall

Miriam Reiner, James D. Slotta, Michelene T. H. Chi and Lauren B. Resnick (2000), *Naive Physics Reasoning: A Commitment to Substance-Based Conception***,** Cognition and Instruction, Vol. 18, No. 1, pp. 1-34

John P. Smith, III, Andrea A. diSessa and Jeremy Roschelle (1993 – 1994), *Misconceptions Reconceived: A Constructivist Analysis of Knowledge in Transition*, The Journal of the Learning Sciences, Vol. 3, No. 2, pp. 115-163

Jones, B. F., Idol, L., (1990), *Dimensions of thinking and cognitive instruction: Implications for Educational Reform,* Lawrence Erlbaum Associates

Clement, J. (1987). *Overcoming students' misconceptions in physics: The role of anchoring intuitions and analogical validity. In J. Novak (Ed.)*. Proceedings of the second international seminar misconceptions and educational strategies in science and mathematics. (Vol. III, pp. 84-96). Ithaca, NY: Cornell University.

Chong, L. (2005), Making sense of learning with schemas. CDTLink Teaching Methods, Vol 9, No 1