

## Culminating Assignment for Patti Cook

### Option 1: Lesson Plan

Title: **Energy: We can't live with it; we can't live without it**

#### Introduction:

This lesson plan is directed at 11<sup>th</sup> and 12<sup>th</sup> grade Environmental Science students. These students have already taken Biology, Earth Science and Physical Science. The students are into the 2<sup>nd</sup> semester and have already studied air and water pollution, human affects on biodiversity, global warming, and acid rain. This is one of the final units of study where much of the information builds upon what has already been covered, and allows students to carry the concepts further and make real life correlations.

The goals of this unit are to understand the difference between renewable and non-renewable resources, the environmental effects of fossil fuel combustion on the environment and to develop recommendations of how humans can reduce the amount of fossil fuels used by energy conservation and alternative fuel sources.

The specific EE Learner Guidelines for Twelfth Grade:

#### **Strand 2.1–The Earth as a Physical System Guidelines:**

- B) Changes in matter**—Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.
- Explain everyday chemical reactions such as burning fossil fuels, photosynthesis, or the creation of smog in terms such as the release or consumption of energy, the products of these reactions, and how these products may be involved in further chemical reactions and/or affect biogeochemical cycles.

#### **Strand 2.1–The Earth as a Physical System Guidelines:**

- C) Energy**—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
- Compare different means of generating electricity (such as coal-burning plants, nuclear fusion reactors, wind, geothermal, and hydropower) in terms of the transformation of energy among forms, the relationship of matter and energy, and efficiency/ production of heat energy.

#### **Strand 2.3–Humans and Their Societies Guidelines:**

- E) Change and conflict**—Learners understand the functioning of public processes for promoting and managing change and conflict, and can analyze their effects on the environment.
- Explain how public decision-making about the environment takes into account (or fails to account for) uneven distribution of, or different types of, costs and benefits; future or distant consequences; and

difficulties assessing the value of certain costs or benefits such as ecosystem services or clean air.

**Strand 2.4—Environment and Society Guidelines:**

**A) Human/environment interactions**—Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs

- Evaluate the cumulative effects of human actions on a specific species or environmental system, such as a stream or a watershed.
- Use the concepts of carrying capacity and ecological footprint to analyze the sustainability of current trends in world population growth and natural resource consumption.

Specific Learner Objectives:

<b>SMART Objective</b>	<b>Level of Bloom's Taxonomy</b>	<b>State Standards Ga QCC's</b>
Upon completion of this unit, students will be able to identify byproducts of fossil fuel combustion and their effects on the environment by drawing a diagram of the formation of acid rain and carbon dioxide pollution	Knowledge, Analysis	7.2 Identifies the chemical equations associated with the combustion of fossil fuels and their by-products. 7.5 Identifies sulfur cycle in the formation of acid rain.
Upon completion of this unit, students will be able to explain how fossil fuels are used to create electricity, in a children's story book production	Comprehension, Synthesis	7.1 Describes the formation and use of fossil fuels. 7.3 Applies the principle of kinetic energy to energy stored in fossil fuels. 7.4 Understands the processes involved in the production of energy as a business enterprise
Upon completion of this unit, students will be able to distinguish between renewable and nonrenewable resources	Analysis	9.1 Differentiates between renewable and non-renewable energy resources.
Upon completion of this unit, students will be able to compare personal and community energy consumption	Analysis	10.1 Applies the law of conservation of energy to fuel consumption. 10.3 Identifies energy efficient devices. 10.4 Compares the amount of electric energy needed to operate various devices
Upon completion of this unit, students will be able to design a proposal for conserving energy, reducing effects of fossil fuel consumption and integrating alternative fuel sources	Synthesis	11.1 Identifies the environmental conditions that favor life. 11.2 Describes the factors that contribute to the major environmental problems. 11.3 Explains how ozone is formed in the stratospheric layer

		and on earth's surface. 11.4 Experimentally determines the effects of acid precipitation on the environment. 11.5 Compares global warming to greenhouse effect and the impact of temperature changes on living things in a lab or field setting.
Upon completion of this unit students will be able to critique personal and community attitudes toward energy conservation.	Evaluation	10.2 Identifies the need for the cost effective use of electricity. 9.2 Recognizes the need for tapping energy from local resources as alternatives.

**Lesson plan: Day 1 Topic: Renewable vs Non-renewable Energy Time: 3hrs**

Objectives/standards: Georgia QCC's: 7.1, 7.2, 9.1, 9.2; EE Learner Guidelines 2.1C, 2.2D

**Activating Strategy: 10 min**

Ask students to take a minute to think about ways in which they have used energy in the last couple of days, then turn to their partner and share these energy usages for two minutes. The students will then create a list of these energy usages on the overhead. Have students suggest possible sources of the energy they used. This could include electricity, gasoline, solar, natural gas, coal, petroleum, wood, water, wind, etc. From this discussion, students will be asked to begin to identify specific types of energy, and question where the energy actually originates.

**Activity #1: PLT # 39 Energy Sleuths: 1hr 30 min**

Teacher will make a list of energy sources on the overhead or whiteboard, including: coal, oil, natural gas, nuclear, solar, geothermal, biomass, wind, hydropower, hydrogen, ethanol, etc. Divide the class into as many groups as are energy sources, (3-4 students), duplicating sources if necessary, or giving groups two sources if there is a small class.

Using resources in the PLT lesson, or information from the NEED Project Secondary Energy INFOBOOK, have students research their energy source, for the following: how it is created, it's availability, how is it used, its economic potential and feasibility of use, pros and cons of its environmental and social impact, the sustainability of it's use, its potential as a future energy source.

The groups will then create a poster of their energy source on chart paper or poster board, becoming “experts” on their energy source.

After all groups have created their posters, each group will present the information about their energy source to the other groups, with the students creating a graphic organizer of this information. As each source is presented, the posters will be hung up on the wall for future reference.

When all posters are hung, allow the students time to do a poster walk, to look closely at each poster, and fill in any missing items on their graphic organizer.

**Mini-Assessment: 5 min**

Have students look or think back to the activating activity, and using their list of energy using activities, make a list of activities and possible sources of the energy for each activity. The students will share with their partner, and make corrections and additions to each others’ list, then the class as a whole will go back to the list on the overhead, and determine the sources of the energy for each activity listed.

**Activity 2: PLT # 14 Renewable or Not?: 20 min**

Teacher will write the terms “renewable resource” and “non-renewable resource” on the white board or overhead. Have students write their own definitions of these terms on a sheet of paper, and give a few examples if possible.

Divide the students into different teams of four and have each team work together to come up with a one- or two-sentence definition of each term. They will use the clue cards and questions provided in the PLT Lesson to synthesize a definition of each term. The teams will then discuss the questions in the lesson and record the team responses. When all groups are finished, have each group share its definitions and answers to the questions. When all groups are finished, develop a class definition for each term, and a class answer for each question.

**Mini-Assessment: 5 min**

Have students look back to their graphic organizer of energy sources and identify each source as renewable or non-renewable. Check their answers with their partner, then have a class check for correct identifications.

**Streaming Video of Renewable and Non-renewable resources: 12 min**

<http://www5.unitedstreaming.com/>

After video, discuss various types of energy sources, their uses, and effects on the environment.

**Activity # 3:PLT # 14 Renewable or Not? Part B:demonstration 1: 30 min**

Popcorn activity to demonstrate sustainable use and renewable and nonrenewable resources.

Fill a large container with popcorn. Mark 14 slips of paper as follows:

2 “1<sup>st</sup> Generation”

4 “2<sup>nd</sup> Generation”

8 “3<sup>rd</sup> Generation”

put the slips in a sack and have 14 students draw a slip.

Ask the 2 1<sup>st</sup> generation students to come up to the container of popcorn. Explain that the container represents the world’s supply of a non-renewable resource. The 2 students can take as much popcorn as they wish and place it into their own paper bags.

When the 1<sup>st</sup> generation has gotten their fill, invite the 4 2<sup>nd</sup> generation students to come up and fill their bags with as much as they want.

When the 2<sup>nd</sup> generation is full, the 8 3<sup>rd</sup> generation students may come up and take what is left.

Discuss what is happening to the world’s supply of this non-renewable resource through out the activity. How much was left for each successive generation? Was there enough left for a 4<sup>th</sup> generation or a 5<sup>th</sup> generation? Did any of the students think about the others as they were filling their bags?

**Homework: give out Watt does it cost worksheet, have students fill out 1<sup>st</sup> column by looking at appliances at home and writing down the Watts used ; bring in copy of power bill**

**Student Journaling: 10min**

Have students write in their journal all the information they have learned today, including the types of energy sources, comparing renewable and non-renewable resources, and how resources might be managed to have a continual supply.

**Lesson plan: Day 2 Topic: Sustainability of Renewable resources; Uses of Energy Time: 3hrs**

Objectives/standards: Georgia QCC’s: 7.4, 9.1, 9.2, 10.1, 10.2, 10.3; EE Learner Guidelines 2.1C, 2.2D

**Activating Strategy: 5 min**

Students will make a list of renewable and non-renewable resources, and check their list with their partners. We will review topics from Day 1.

**Activity # 1:PLT # 14 Renewable or Not? Part B:demonstration 2: 30 min**

Divide the group into teams of four. Give each team 16 pieces of popcorn. Explain that the students will play a game where the popcorn represents a renewable resource and it is replenished after each round. Each student can take freely from the group supply, should take at least one piece of popcorn, and after each round, the popcorn will be replenished by one half. If there is not one piece for a player, that player dies.

Each round, students should take freely from the resource, recording how much they take and how many are left. Replenish the pile after the round, and continue playing for 4 or 5 more rounds.

Have students share amongst groups. Did all members survive? Which team had the most popcorn in its middle pile? Which teams would be able to keep their resource forever as long as it kept renewing itself.

Discuss the included questions with the class from the lesson. Be sure to introduce the concept of sustainable yield.

**Streaming Video: How is electricity produced; measuring energy; efficiency and conservation** <http://www5.unitedstreaming.com/> 28 min

Have students take notes on electricity including units of measurement, types of electricity used in homes, what does the Energy Guide represent?

**Watt does it cost to use it? Alliance to Save Energy's Green Schools Program: 1hr 45 min**

Have several household electrical appliances displayed on table (incandescent lamp, fluorescent lamp, egg beater, space heater, VCR, hair dryer, CD player, clock, computer printer, cell phone charger, TV, and toaster).

“What is a watt?” use an apple or 100 g mass next to a vertical meter stick, and lift it to the top of the meter stick in 1.0 sec. “How much power did it take?” 1 watt- energy to lift 100 g 1 meter in 1.0 sec.

Have students read labels on several electrical items on display. Use the included chart to record their findings in the first column with those they recorded from home last night. Students should then identify BIG users (>200W) and check them off under the 2<sup>nd</sup> column. “Can you make generalizations about the big users?” Students should then determine which items run more than 1 hour per day.

Define kilowatts and explain how watts(w) compare to kilowatts(kW).

Discuss how to come up with the formula that is used to measure electrical energy.

Energy = Power x time kWh

Going back to the worksheet, as a class estimate the amount of time each appliance might be on per day.

Now, using the energy formula, P x time, have students calculate the energy use per day for each appliance.

Finally, have students use the power bills they brought from home, or a copy you have made on a transparency to determine the cost per unit(kWh) for your county.

$\$ = \$/\text{kWh} \times \text{kWh used}$

Students should then calculate the cost per day of each appliance, and a cost per year by multiplying by 365.

Discuss the costs of various appliances, and ways to reduce their usage throughout the day. Why is it important to conserve energy? Is it just for cost or is it to conserve nonrenewable resources?

Discuss “Energy Star” symbol on many new appliances, and Energy Guide ratings on all major appliances.

**Homework: Crunch the numbers: Visit this website and calculate the information about energy usage in the United States:**

**<http://www.eia.doe.gov/kids/classactivities/CrunchTheNumbersIntermediateDec2002.pdf>**

**Student Journaling: 10min**

Have students write in their journal all the information they have learned today, including the types of appliances used and which ones use the most energy. How to determine more energy efficient models, and why is it necessary to conserve energy?

**Lesson plan: Day 3 Topic: Types of energy used to produce electricity Time: 3hrs**

Objectives/standards: Georgia QCC’s: 7.4, 9.1, 9.2, 10.1, 10.2, 10.3; EE Learner Guidelines 2.1C, 2.2D

**Activating Strategy: 10 min**

Have students look over their “Watt does it cost to use it” worksheet and make a list of appliances they used in the last 24 hours, calculating how much energy they used in the last 24 hours, then share with partner the amount of energy used. Students can share information gathered from the internet “Numbers Crunch” from last night.

**Guest Speaker: Greystone Power Company 1 hr 30min**

Speaker to discuss types of energy sources used to generate the electricity in Georgia and specifically in Paulding county. Include in the discussion the main source of electricity, minor sources, alternative sources or “green power” such as methanol and solar panels. Explain the intricacies of generating electricity, and converting solar energy into electricity, the use of generators and a/c versus d/c current.

Included with speaker is a tour of our own mini solar panel plant, donated by Greystone Power, with 6 solar panels generating 1000 watts of power. He will also discuss how the panels work, how the practice would work on a home or business, as well as examples of green businesses such as BP Direct gas stations, who use solar panels to run their night lights.

Students can share information gathered from the internet “Numbers Crunch” from last night.

**Laboratory Investigation 11.2: Holt Environmental: Smokestack in a bottle: 45 min**

Students assume the role of engineers for an energy plant that burns fossil fuel. There is smoke coming from the smoke stack and it is blacker than usual. Where is the material coming from and what should you do about it?

Students use a candle to represent smoke stack. By passing a metal spatula through the flame, a black substance can be collected. What is it? Where did it come from? Students then research the components of fossil fuels using their text or the internet. (carbon from organic matter)

When is the most smoke generated, and how could the black smoke be controlled or reduced? Again students research their text or internet (scrubbers).

Students as engineers must also determine what gases are being given off by smoke stack. Place candle in a sealed container and test gases with a solution of calcium carbonate. What gases cause precipitates to form with calcium carbonate? Students research text or internet. (Carbon Dioxide) What effect does CO<sub>2</sub> have on the atmosphere? Students research text or internet (global warming).

Another part of your job as engineer is to order new fuel supplies. You learn about a new supplier with cheaper fuel, but it is not as pure and contains more nitrogen and sulfur. These elements react with oxygen in the air creating nitrous oxides and sulfur oxides. Can these compounds effect the atmosphere? Students research text and internet. (acid rain formation)

**Web Quest: Alternative Energy Sources: Begin to work on Final Project 30 min**

<http://www.dmrctc.net/~embrys/aesindex.htm>

Have students choose groups of four students and select the energy source they wish to use on the web quest. The students will read their task and assign roles to each student, and begin gathering information for this project.

**Student Journaling: 10min**

Have students write in their journal all the information they have learned today, including the types of power plants in Georgia and Paulding county, how much of each we use, how much “green power” we use, how solar panels work, and what are some environmental effects of using fossil fuels for electricity.

**Lesson plan: Day 4 Topic: Effects of fossil fuels on the environment Time: 3hrs**

Objectives/standards: Georgia QCC's: 7.2, 7.5, 11.2, 11.4, 11.5 EE Learner Guidelines 2.1 B, 2.1 C, 2.2D, 2.3 A, 2.4 A

**Lab Investigations 6.1: Holt Environmental: Testing Acid, Tracking Rain 1 hr min**

Students will learn how to measure pH and understand the concepts of acid and bases. Then students will study the effects of CO<sub>2</sub> on the pH of water, by exhaling into the water sample with a straw, and recording the pH every 10 seconds, for 120 seconds. Next the students will determine the effects of pH on a microorganism, yeast. By taking a live yeast culture and check under microscope to see active budding. Yeast will be observed under conditions of different dilutions of Sulfuric acid. Each group will have a

different concentration of sulfuric acid, and record the pH and budding activity of their yeast on a class data table. Students will then be able to observe and discuss the effects of changes in pH on microorganisms.

Finally, the students will track the movement of acid rain across an area by marking the map with an x whenever the rain pH was below 5. After completing the activity students can predict the direction in which the acid precipitation is originating and traveling.

Students will then write a paragraph describing how they reached their conclusion, with evidence to support it, and suggest possible culprits for the acid rain.

**Web Quest: Alternative Energy Sources: Continue the group work on Final Project 45 min**

<http://www.dmrctc.net/~embrys/aesindex.htm>

**Activity # 3: Design Bumper Stickers for Alternative Energy Sources: 1 hr 15 min**

Students will use the information they have learned this week to design a bumper sticker promoting an alternative energy source or persuading against an energy source.

**Lesson plan: Day 5 Topic: How can humans conserve energy and protect the environment? Time: 3hrs**

Objectives/standards: Georgia QCC's: 7.4, 9.1, 9.2, 10.1, 10.2, 10.3; EE Learner Guidelines 2.1C, 2.2D

**Activation activity: 10 min**

In their journals, students respond to the following questions (written on the board before class): "Remember a time when you were without power-- when your energy source failed you. What happened and why? What were you unable to do? How did you overcome the situation?" You might remind students of storms knocking down power lines, car batteries dying, and so on. As a group, share responses and guide students to understand that in situations like this, we can be resourceful and use alternatives to our regular power sources. Brainstorm on the board different types of energy sources. What technologies use human energy for power?

**Activity #1; Read an article and answer questions in your journal 20 min**

As a class, read and discuss "Power from the People Breaks the Hold of Batteries and Plugs," focusing on the following questions:

- Describe the "tyranny of the disposable battery" in your own words. What are the reasons people may need alternatives to the "electricity grid"?
- What are some examples of things that have been powered by human energy for many years? What is the difference between these and the new inventions?
- How do the Freeplay products work?
- Why did Freeplay's sales rise last year?
- In terms of harvesting human energy, what are the implications for laptop computers, pagers, cell phones and P.D.A.'s?

- f. Why is the Massachusetts Institute of Technology's approach described as "sneaky"?
- g. What interest does the military have in human-energy research?
- h. What sorts of transportation might eventually use human energy?
- i. Why is an ornithopter described as an odd sight?

**Web Quest: Alternative Energy Sources: present Energy Projects 1hr 30 min**

<http://www.dmrctc.net/~embrys/aesindex.htm>

Student groups make their presentations to the class panel, for each of the energy groups.

**Activity # 2: Writing policy statements; 1 hr**

Writing as if they were government scientists recommending a new government policy on energy, students write policy statements on the topic. They should refer to information from their group presentation as well as the presentations of the other groups. Students should address the following issues in their policy statements:

- What is the most environmentally friendly energy source?
- What laws should be made regarding different energy sources?
- Should any sources be forbidden? Should any be required?
- How should industries be regulated in their use of energy?
- Does human energy have any negative implications for the future?

Students share their papers in class.

**Further Questions for Discussion:**

- What do you think life would be like with only human power?
- What do you think inspired Rory Stear, the CEO of Freeplay Energy, to develop these products?
- Do you think that we as a country are too dependent on our power sources? Why or why not?
- Do you think that if we had to generate our own power, like these new products would require, we would use as much energy as we do now with the electric grid? Why?
- What do you think will become of the idea of human power?

**Assessments:**

Formative assessments: During each daily activity, students are assessed on participation and answers to oral questions as well as completion of graphic organizers, posters, journal entries, lab activities, mini-assessments.

Summative assessment: Completion of the web quest according to grading rubric, evaluation of the policy statement.

