PROJECT REPORT

Northern Wyoming Community College District / National Science Foundation
Summer Energy Education Program 2012

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TITLE

ENERGY: Behind The Scenes

SUMMARY

Background: Many students struggle with Science As Inquiry and Transformation of Energy. This activity connects the bridge between these two entities and provides a strong link where students can make real world connections and obtain success on standardized assessments.

Motivation: In Louisiana alone there are 108 power plants which supply all parishes with energy for electricity. Our state has lots of energy sources. Let's explore behind the scenes!

Nuclear energy is competitive with fossil fuels (coal, gas, and oil) for electricity generation. The high capital costs for initial embarkment and the need to carefully dispose waste must be given serious consideration when determining which source is most economical. If the social, health and environmental costs of fossil fuels are taken into account, the economics of nuclear power are outstanding. When given three points of reference:

1. research based electricity trends in a chart with kilowatt power for oil, gas, coal, and nuclear energy
2. the visual appeal of a coal plant (Dry Fork Mine) and a nuclear power plant (Uranium One Willow Creek Project) plant via power point,
3. reference sheets on coal and uranium

The students will create a line graph displaying the cost comparison between oil, gas, coal, and nuclear energy from the time they were born until present. Ultimately, they will assimilate all three references and predict which one is the most dynamically economic.

ENERGY CONTEXT

Coal is mined and generated to create almost half of all the electricity in the United States. Dry Fork Mine in Wyoming is an exemplary coal-based electric generation station. It generates and distributes electricity to about 2.8 million consumers. Coal from the mine is drafted for fuel through a one mile conveyor system. Water is heated to make steam which turns turbines (machines for generating rotary mechanical power) connected to generators that generate electricity. Geologists at Dry Fork apply a complex pulverized coal (PC) technology system along with the most up to date generation of pollution control technologies that result in very low

release of gases.

Nuclear fuel costs are noticeably less than coal. Uranium (U3 O8), a metal found in rocks, is used in nuclear reactors such as the conventional Uranium One Americas ISR Technology and Willow Creek Project in Wyoming. Uranium One fuels nuclear power that produces a whopping 16% of the world's electricity! At the Uranium One Willow Creek Project in the Powder River Basin in Wyoming, uranium is extracted from underground in sandstone aquiferous deposits**.** They rely on a complex uranium removal system from the ore body that interacts with circulating groundwater where heat is produced to eventually become electricity. Instead of burning fossil fuels (coal, gas, oil) to produce the steam, they use steam from heated water to turn large turbines, which generate electricity with little by product. All processes are continuously controlled and monitored with computerized automation.

STANDARDS

Science as Inquiry

*Identify problems, factors, and questions that must be considered in a scientific investigation (SI-M-A1)
*Use a variety of sources to answer questions (SI-M-A1)
*Design, predict outcomes, and conduct experiments to answer guiding questions (SIM-A2)
* Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment (SI-M-A2)
*Trace energy transformations in a simple system (PS-M-C2)

Energy

*Describe how electricity can be produced from other types of energy (e.g., magnetism, solar, mechanical) (PS-M-C6)
* Compare forms of energy (e.g., light, heat, sound, electrical, nuclear, mechanical) (PS-M-C1)
*Identify risks associated with the production and use of coal, petroleum, hydroelectricity, nuclear energy, and other energy forms (PS-M-C8)

ANTICIPATED TIME REQUIRED

1. Teacher directed student led " thumbs up" review of coal energy vs. nuclear energy (KNOW/DON'T KNOW/UNSURE) Students can highlight reference sheets as a guide during the review. – 15 min

2. POWERPOINT: NUCLEAR ENERGY v. COAL ENERGY
   Dry Fork Station and Uranium One: - 20 min
   Students will develop a clear visual of the two types of energy sources

3. Think/Pair/Share Game – Pros / Cons of Coal vs. Nuclear Energy as a source of electrical energy (Reference sheet should be available): - 15 min ALTERNATIVE: Modified VENN DIAGRAM

4. Construct energy line graphs in cooperative groups or individually (EXCEL) using research based data. – 25 min. GRAPHING APPEARS ON EVERY STATE STANDARDIZED ASSESSMENT

5. Formulate predictions, rank sources, and establish base line comparisons by responding to critical thinking questions and case study based on data collection in the line graph. –

15 min.

CONSTRUCTIVE RESPONSES ARE AN INTEGRAL PART OF STANDARDIZED ASSESSMENTS

6. COOKIE MINING LAB

INTENDED STUDENT LEVEL

The intended activity based learning project, assessment, and extension will be presented to 6th Grade (Physical Science) including SPED and ESL.

ASSUMED PRIOR KNOWLEDGE

This project will assume that students have prior knowledge of:

- Reference sheet information will have been given previously for student review and reinforcement
- Ability to construct a line graph with all parts correctly labeled. Advanced students will be given the option of data input through EXCEL.
- Group work etiquette pre-established

LEARNING OBJECTIVES

- Students will develop a deeper appreciation for the field of geology and energy and continue to pursue this interest.
- Observe and analyze the Dry Fork and Uranium One power point as a realistic/idealistic example for further insight into energy usage and consumption.
- In cooperative groups, students will create a notecard containing the pros and cons of coal vs nuclear power based on guided references (handouts, and power point)
- Critique peer partner responses and defend own views. NO SILENCE ALLOWED!
- Students will use activity based learning to determine the most cost effective method for electricity by completing a U.S. Electricity Production cost efficiency line graph that begins with their birth year.
- Students will assess current trends and a case study and justify the most cost effective and safe method of electricity that will directly impact their economic future by summarizing the data and responding to high level critical thinking questions.

MATERIALS

Each group will need:

- Coal and Uranium reference sheets
- Notecards
- Graph paper
- Colored pencils
- Student Response handouts

INTRODUCTION / MOTIVATION FOR STUDENTS

COAL ENERGY
Advantages:

1. Coal is located almost universally.
2. Coal is a reliable long term source of power and can be generated easily.
3. Investing in coal is low cost and mines can be built easily.
4. The potential to produce energy is high compared to other fossil fuels.

Disadvantages

1. Burning coal releases harmful substances in the air and water causing health hazards and acid rain.
2. Coal mining results in quite a few human deaths per year although conditions and technology have improved.
3. Habitat destruction and loss of landscape may result as trees are removed.
4. Coal is combustible and may cause fires.

NUCLEAR ENERGY
Advantages:

1. 250g of uranium produces 20000 times more electricity than 250g of coal and is far less polluting, especially to our atmosphere, as no harmful greenhouse gases like are emitted. (carbon monoxide, sulphur dioxide, nitrogen oxide etc.).
2. One barrel of uranium concentrate (900 lbs.) has the equivalent electric generating capacity of 13,600,000 pounds of coal, or 24,000 barrels of oil.
3. It is generally a reliable process that can be counted on to produce electricity for many years (average availability over three years is about 80%).
4. The amount of waste produced each year is minimal.
5. Uranium can produce 3.7million times as much energy as the same amount of coal.

Disadvantages

1. There is pollution in the form of radioactive waste but with new technologies the process is becoming cleaner and safer each year.
2. The possibility of radiation leakage or plant meltdown is very unlikely. There are procedures in place to ensure safety.
3. There are problems and dangers, which could lead to accidents. Many parts of the plant are computerized with some manual work and little error..
4. The reactors are very expensive in the beginning, but costs are cheaper in the long run.
5. Uranium can produce 3.7million times as much energy as the same amount of coal.

PROCEDURE

1. Whole group review with “thumbs up” game and use of reference sheet
2. View: Dry Fork and Uranium One PowerPoint as a means to compare electricity received from both coal and uranium.

3. Think/Pair/Share game to reinforce base line comparison of each source respectively.- NO SILENCE ALLOWED (peer partners)
4. ACTIVITY: U.S. Electricity Production Cost comparison line graph of 4 types of energy sources for electricity (NEI)
5. Assess student responses, predictions, and justifications via higher order critical thinking questions.

SAFETY ISSUES

Ensure constant monitoring to guarantee that all students are working and on-task, and not jabbing each other playfully with the colored pencils.

TROUBLESHOOTING TIPS

Teacher may have to review basic graphing techniques via mini presentation of graph construction.

ASSESSMENT

Pre-Assessment Activity: GAME: THUMBS UP

Assessment:

Teacher led student directed questions and reflection

1. What do coal and uranium have in common? The original products are found in the Earth. They must be mined. Both are dangerous, but beneficial.
2. Which source do you think will be most beneficial to you in the future? Why?

   Ensure that student answer is rational.

Activity Embedded Assessment

U. S. Electricity Production Costs

Students will create a line graph from the chart below comparing the production cost of petroleum, gas, coal and nuclear power by year. They will use a different colored pencil to represent each source respectively. The graph must have an appropriate title and the x and y axis must be labeled.

HINT: X-axis Title: Years

Y-axis Title: Cost at Kilowatt per hour

	1995	1999	2003	2007	2011
Petroleum	6.0	4.0	7.0	10.0	16.0
Gas	4.0	4.0	7.0	5.0	4.0
Nuclear	3.0	3.0	2.0	2.0	2.0
Coal	3.0	3.0	3.0	3.0	3.0

Teacher led student questions and reflection

3. Which energy source appears to be most economical? Nuclear
4. Justify your choice with at least three reasons.

   Data from line graph and chart shows that nuclear is consistently cheaper.

Post Activity Assessment

1. Why is the use of nuclear energy controversial? Dangers vs. Benefits
2. Do you think the benefits of nuclear power outweigh the potential dangers?
   Ensure that student answers are rational.

Case Study

During the Cold War in the 1900s, the United States and the Soviet Union built up stores of atomic weapons. At the end of the Cold War, they reached agreements to limit the number of atomic weapons. Do you think all countries should agree to limit atomic weapons? Explain.
Ensure that answers are rational.

SUGGESTED EXTENSIONS

Students will complete an energy scavenger hunt found at www.eia.doe.gov. This is a fun engaging, and extensive technology infused activity geared towards:

*building energy vocabulary
*expanding knowledge base
*engaging kinesthetic learners