

Choosing a Type of Power Production

Major Topic: Energy conversion, generators, and nuclear energy.

PBL Topic: The city of Richmond, Virginia, is examining its methods for producing energy. What is the best method of electrical generation that should be used to increase the electrical power available in Richmond?

Length: 4 - 90 minute blocks

Stage 1 - Desired Results	
<p>Established Goals:</p> <ul style="list-style-type: none"> ● The student will demonstrate an understanding of scientific reasoning, logic and the nature of science by planning and conducting investigations. ● The student will investigate and understand changes in matter and the relationship of these changes to the Law of Conservation of Matter and Energy. ● The student will investigate and understand forms of energy and how energy is transferred and transformed. ● The student will investigate and understand the scientific principles of work, force, and motion. ● The student will investigate and understand basic principles of electricity and magnetism. <p>VA SOL:</p> <ul style="list-style-type: none"> ● PS.1 j, k, m, n ● PS.5 b, c ● PS.6 a, b ● PS.10 c ● PS.11 a, b, c 	
<p>Understandings: <i>Students will understand that...</i> j) valid conclusions are made after analyzing data; k) research methods are used to investigate practical problems and questions; m) models and simulations are constructed and used to illustrate and explain phenomena; and n) current applications of physical science concepts are used. b) chemical changes; and</p>	<p>Essential Question(s):</p> <ul style="list-style-type: none"> ● <i>How do things like coal, uranium, wind and sunlight get turned into electricity?</i> ● <i>How does using the different resources affect us and the environment?</i> ● <i>How is electrical energy transferred to our homes and businesses?</i>

<p>c) nuclear reactions. a) potential and kinetic energy; and b) mechanical, chemical, electrical, thermal, radiant and nuclear energy. c) work, force, mechanical advantage, efficiency, and power; and a) static electricity, current electricity, and circuits; b) relationship between a magnetic field and an electric current; c) electromagnets, motors, and generators and their uses; and</p>	
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Student objective (outcomes):

Students will know...

A generator is a device that converts mechanical energy into electrical energy. Most of the electrical energy we use comes from generators. Electric motors convert electrical energy into mechanical energy that is used to do work. Examples of motors include those in many household appliances, such as blenders and washing machines.

- Electricity is related to magnetism. Magnetic fields can produce electrical current in conductors. Electricity can produce a magnetic field and cause iron and steel objects to act like magnets.

Several factors affect how much electricity can flow through a system. Resistance is a property of matter that affects the flow of electricity. Some substances have more resistance than others.

Energy is the ability to do work.

- Energy exists in two states. Potential energy is stored energy based on position or chemical composition. Kinetic energy is energy of motion. Students should know that the amount of potential energy associated with an object depends on its position. The amount of kinetic energy depends on the mass and velocity of the moving object.
- Important forms of energy include radiant, thermal, chemical, electrical, mechanical, and nuclear energy. Visible light is a form of radiant energy and sound is a form of mechanical energy.
- Energy can be transformed from one type to another. In any energy conversion, some of the energy is lost to the environment as thermal energy.

Another type of change occurs in nuclear reactions. Nuclear energy is the energy stored in the nucleus of an atom. This energy can be released by joining nuclei together (fusion) or by splitting nuclei (fission), resulting in the conversion of minute amounts of matter into energy. In nuclear reactions, a small amount of matter produces a large amount of energy. However, there are potential negative effects of using nuclear energy, including radioactive nuclear waste storage and disposal.

Chemical reactions are classified into two broad types: ones in which energy is released (exothermic) and ones in which energy is absorbed (endothermic).

In chemical changes, different substances are formed.

The Law of Conservation of Matter (Mass) states that regardless of how substances within a closed system are changed, the total mass remains the same.

The analysis of data from a systematic investigation may provide the researcher with a basis to reach a reasonable conclusion. Conclusions should not go beyond the evidence that supports them. Additional scientific research may yield new information that affects previous conclusions.

- Different kinds of problems and questions require differing approaches and research. Scientific methodology almost always begins with a question, is based on observation and evidence, and requires logic and reasoning. Not all systematic investigations are experimental.

Investigation not only involves the careful application of systematic (scientific) methodology, but also includes the review and analysis of prior research related to the topic. Numerous sources of information are available from print and electronic sources, and the researcher needs to judge the authority and credibility of the sources.

Students will be able to...

explain the relationship between a magnetic field and an electric current.

- construct simple circuits to determine the relationship between voltage, resistance, and current.
- compare and contrast generators and motors and how they function.

explain how the concepts of work, force, and motion apply to everyday uses and current technologies.

differentiate between potential and kinetic energy.

- use diagrams or concrete examples to compare relative amounts of potential and kinetic energy.
- identify and give examples of common forms of energy.
- design an investigation or create a diagram to illustrate energy transformations.

describe, in simple terms, the processes that release nuclear energy (i.e., nuclear fission and nuclear fusion). Create a simple diagram to summarize and compare and contrast these two types of nuclear energy.

- evaluate the positive and negative effects of using nuclear energy.

compare and contrast physical, chemical, and nuclear changes.

- identify the reactants and products in a given chemical equation formula.
- design an investigation that illustrates physical and chemical changes.

gather, evaluate, and summarize information, using multiple and variable resources, and detect bias from a given source.

- formulate conclusions that are supported by the gathered data.

communicate in written form the following information about investigations: the purpose/problem of the investigation, procedures, materials, data and/or observations, graphs, and an interpretation of the results.

use current technologies to model and simulate experimental conditions.

Stage 2 - Assessment Evidence

Performance Task(s):

1. Fill in a table that compares different aspects of four different energy sources.
2. Create a diagram of a generator that explains how a fuel source is converted into electrical energy.
3. Choose a location on a map that will fit the needs of an energy production facility and write a short paragraph that explains why that location was chosen.
4. Create an advertisement that uses scientific facts to persuade citizens of the Richmond area to back a specific power source.
5. Write a short paper that summarizes the scientific reasoning for a specific power source in Richmond as well as uses quotes from others who back the same power source.

Stage 3 - Learning Plan

Technology:

- Computers with internet access
- Google maps
- Google docs (or Microsoft Office)

Materials:

- Directions Page
- Checklist/Rubric (included)
- Written Paper Rubric
- List of suitable resource links
- Map page
- Generator page
- Poster paper/art supplies (If poster chosen for ad)

Lesson Format:

ENGAGE: (Day 1)

This lesson should follow a class in which students are shown different energy sources and how technology has allowed us to turn those different energy sources into electricity.

Students should be divided into groups of 2-4. Each group should also have access to a computer for each student. If computers are at a premium, a minimum of 2 per group will be necessary to complete all tasks within four class periods.

Begin by showing the students the problem, "Richmond needs more energy!" Explain that as population increases, industry grows, and technology progresses, there will be a need for more electrical energy access in our part of the country as well as throughout the world. Background knowledge (previous lessons), allowed them to learn the many different ways to get that energy, each with its own sets of pros and cons.

Explain that their task will be to...

1. Explore the different energy sources to determine how the different pros and cons may affect our region.
2. Decide what source of energy makes the most sense for our region and be prepared to back that up with scientific facts.
3. Be able to explain how their chosen energy source works.
4. Find a location that will fit the needs of their energy source.
5. Create an advertisement that will try to get the people of our region to back their decision using factual arguments.
6. Write a short persuasive paper that summarizes their findings.

EXPLORE:

At this point, each group should be given the data collection paper and be instructed to

divide up the research. Having a set of links of appropriate places to look for information will be very helpful. If a projector is available, display the following information:

Part 1: Information Gathering

1. *Log into as many computers as you can in your group.*
2. *Go to (INSERT A LOCATION WITH LINKS TO GOOD RESEARCH SITES)*
3. *Begin deciding as a group which type of power plant you think would be best to add to Richmond.*
4. *Start looking up and recording information on different power plants. I have given you some links of places to start looking. You may go to other websites, but make sure they are reputable sources. If you're not sure if it's reputable, come and ask me.*
5. *You will need to find 2 quotes to put in to your final paper that support your plant type. Be sure to record where those quotes come from and make a citation using easbib.com. If you need help citing be sure to see me.*

Allow students approximately 30 minutes to begin collecting information and during this time, walk around and discuss with each group what their initial thoughts are for what type of energy source they want to back.

*A data collection paper should be designed for them to gather information on 4 different energy sources. If they are having a hard time deciding what energy source they think is best, suggest to the group to look up the information on the ones they are arguing between to help make their decision. If the group all agrees already, explain they will need information on other energy sources to compare with theirs so they can point out areas they believe it to be superior.

EXPLAIN:

After students have had time to begin collecting information on different energy sources, go over all of the tasks they will need to complete again. As a class, go from group to group and have each state what type of plant they are going to be arguing for and a few reasons why. Be sure to steer the discussion back to scientific facts when necessary and remind students that there isn't one correct answer. There are several correct answers depending on which aspects of the power sources the students decide are most important (i.e. economics vs short term environmental vs long term environmental).

ELABORATE: (Day 2/3)

Give each group a grading rubric, a diagram page, a directions page, and a checklist. They will then be in charge of dividing up the work to complete the tasks below. Students will be given the rest of the day (~30 minutes), the whole next block, and the first half of the following day to complete this section. Begin the 2nd day with a summary of their tasks and by circulating to

each group to check on progress. If a projector is available, display the following information:

Part 2: Creating the Power Plant Map

1. *Open the map of Richmond using the link below...*
<https://www.google.com/maps/preview#!data=!1m4!1m3!1d157951!2d-77.4932614!3d37.524661>
2. *Think about the requirements of your power plant and use the virtual map to help find a location in the map on your paper that can support your power plant. For example, does it need access to lots of water, does it need to be near a railroad, can it be near people or does it need to be isolated, near the highway?*
3. *Draw your plant onto the map and write a justification for why you chose that location. Be sure to check the rubric to make sure you cover all of the points.*

Part 3: Persuasive Paper Writing (You may choose to make a presentation instead of a paper, each paragraph would equal 2 slides.)

1. Write a paper with a minimum of 3 paragraphs.
 - First paragraph introduces the energy source/powerplant type you want to bring to Richmond and briefly states why.
 - The middle paragraphs point out why your energy source is better than other options focusing on FACTS not opinions gathered during your research.
 - The closing paragraph summarizes your argument.
2. Your paper must include 2 quotes and proper citation that support your chosen plant type.
3. Your paper should be typed. Use google docs to type your paper so you won't have to worry about saving it. If you choose to do a presentation, use google docs or powerpoint and use pictures as much as you like as long as you cite your sources.
4. Be sure to check the rubric to make sure you cover all of the requirements.

Part 4: The Generator Diagram:

1. Research how your plant converts its fuel into electrical energy. For example, if you are arguing for coal power, google, "how does a coal plant turn coal into electricity?" You should also look up a diagram to help get started. Look up something like, "coal power plant diagram," in google images.
2. Draw a diagram on the diagram page that shows the process from start to finish. It should include labels describing what happens during each step.
3. Be sure to label all of the reactants (things needed at the beginning such as fuel and other materials) and the products (things that come out of the plant including electricity, heat, pollutants, etc.).

Part 5: Advertisement:

1. With your group decide whether you want to make a commercial, poster, or radio ad convincing the citizens of Richmond that they should back your power plant.
2. See the rubric for the requirements for your project type. You can use movie maker, audacity, or any other program you like if you are making a radio ad or commercial. If you are simply making a poster, get big paper from me and feel free to use my colors.
3. Be sure to check the rubric when you're done to make sure you've covered all of the points.

EVALUATE: (Day 4)

- On the fourth day, pass each group a new checklist. Remind them to go through the checklist and the rubrics to make sure they have completed everything. Also, any students with digital copies of any components should note how they are turning it in (i.e. google docs, flash drive, email, etc.)
- Have something for students to begin working on as they finish and collect work with a set time that everything must be in by.
- Have the students present their advertisements, arguments and findings to the class.
- Use the rubrics to evaluate the student's' work. After they are all finished, if possible, share the grade with each group at a time so they can understand their grades.

*Lesson format adapted from UBD design by Grant Wiggins and Jay McTighe, 2004

Student Checklist/Teacher Rubric

Names		Check here if you have it.	Points
1	Comparison Table (15)		
2	Diagram of generator (10)		
3	Map of location (15)		
4	Advertisement (30)		
5	Persuasive Paper (30)		
	Total Score (out of 100)		

Teacher Comments: