

Renewable Energy –Blowing in the Wind

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Introduction

Renewable Energy

Nature has gifted us with many products without which we would not be in the condition we are today. Today, we might say that we are “developed”, but it would not have been possible without the gifts that Mother Earth has provided us. Almost all types of resources from nature are used by human beings. Some resources are limitless and some are limited and will eventually be depleted. Some might be used again while some will lie around unused and simply go to waste. I would like to teach my students that renewable energy is the driving force behind keeping our planet sustainable for years to come. Students will be able to identify five sources of renewable energy. Students will learn how each of these different sources of renewable energy work and will understand how renewable energy provides clean sources of energy.

Demographics

I work in the Christina School District. Currently I teach in the city of Wilmington, Delaware. The student demographics are 82.3% African American, 8.7% Hispanic, 6.3% White, and the school is 80.3% low income according to Delaware standards. We are the largest elementary city school within the Christina School District. The school is comprised of approximately 421 students. 33% of our students are classified as special education. This year my principal has decided to departmentalize and as a result I have been fortunate to teach the entire fifth grade math and science curriculum. The unit my students have enjoyed the most in the past has been the ecosystems unit. My goal this year is to increase scientific rigor in my classroom as a result of increasing science understanding I will incorporate renewable energy into the unit along with an additional school trip. During my lessons, I joke a lot with my students, but all are involved and

remain on task. My goal is to get students to fall in love with science; I hope they will want to pursue a career in the field. One of the many challenges urban schools often face is students are not exposed to field trip experiences and often times they do not learn or go to locations where they can have hands on experiences with the world in its natural setting. This unit however, will allow educators to govern field experiences and open opportunities for urban students to learn about the natural environment. This premise is very easy to incorporate, and students will love learning how human activity affects the ecosystem. The intended audience for this unit is fifth grade.

Students will learn three main categories of energy – fossil fuels, alternative energy, renewable and nonrenewable energy. Fossil fuels refer to resources created by millions of years of heat and pressure on prehistoric plants and microorganisms. For example: Coal, petroleum (oil), and natural gas are concentrated organic compounds found in the Earth's crust. According to the US Energy Information Administration (EIA), fossil fuels meet 81 percent of U.S. energy demand. Alternative energy refers to any form of energy that is not a fossil fuel; this includes renewable and nuclear energy. Renewable energy refers to sources of energy that can be replenished in a human lifetime. These categories are further broken down into individual energy resources such as oil, coal, wind, solar, hydro and nuclear. Each requires specific and unique processes to be converted into usable forms of energy.

Students will learn the following: Form, Distribution and Use.

Form: (Form refers to the states energy has been converted to so that it can be efficiently utilized for its end use) Energy can neither be created nor destroyed; it simply changes form. Raw natural resources must be converted to usable forms of energy so that they can be consumed to perform work.

Distribution: (Distribution refers to the various technologies that enable the delivery of usable energy forms to the places where they will be consumed). Once a natural resource has been converted into a usable form of energy it needs to be delivered to consumers (for example electricity and fuel).

Use: (Use is the service that people acquire from energy). Ultimately, the reason our energy system exists is so that our society can benefit from the services that energy enables. Energy allows us to transport ourselves efficiently from point A to point B, stay warm in cold months or cool in hot months, have light and power to run our various home appliances; the list could go on and on. Energy is the ability to do work and therefore its use can be thought of as all the ways in which energy allows us to do work.

Background

In the United States, most of our energy comes from nonrenewable energy sources. Coal, petroleum, natural gas, and uranium are examples of nonrenewable energy sources. Nonrenewable energy sources are used to make electricity, to heat our homes, to move our cars, and to manufacture products these energy sources are called nonrenewable because their supplies are limited. Petroleum, for example, was formed millions of years ago from the remains of ancient sea plants and animals. For this particular science unit I will be focusing primarily on renewable energy sources. America's electric companies are involved in producing and distributing renewable energy throughout the country. From wind to solar to biomass; electric companies are leading the way in providing renewable energy for America. The five renewable sources I will teach my fifth grade students and the sources most often used are: Biomass, Geothermal, Water (Hydropower), Wind, and Solar.

Biomass: is a fancy name for material from plants and animals. Some kinds of biomass can be burned to produce energy. One common example is wood. When we use plants as a source of energy we are converting the energy they have stored from the sun. Using the methane gas given off by landfills and animal waste is also becoming more common. Another increasingly popular form of biomass is in the form of biofuels such as ethanol and biodiesel, which is also derived from plants and animals. Biomass contains stored energy. Plants absorb energy from the sun through the process of photosynthesis. When biomass is burned, this stored energy is released as heat. Burning biomass releases carbon dioxide. However, plants also take carbon dioxide out of the atmosphere and use it to grow their leaves, flowers, branches, and stems. That same carbon dioxide is returned to the air when the plants are burned. Many different kinds of biomass, such as wood chips, corn, and some types of garbage, are used to produce electricity. Some types of biomass can be converted into liquid fuels called biofuels that can power cars, trucks, and tractors. Leftover food products like vegetable oils and animal fats can create biodiesel, while corn, sugarcane, and other plants can be fermented to produce ethanol. A disadvantage to the use of biomass is that land has to be set aside for crops which in turn means less land for food production

Geothermal: Uses heat generated by the earth's interior. By drilling down into the Earth's crust, much like we drill for oil, we use heat within the earth's crust to generate electricity. Geothermal is also a good source for heating homes and buildings. It shows itself in the fountains of boiling water and steam known as geysers. Geothermal energy was generated, by the decay of natural radioactive materials within the earth. In addition,

it is the heat energy remaining within the earth from gravitational formation of the earth. Geothermal water from deeper in the Earth can be used directly for heating homes and offices, or for growing plants in greenhouses. Some U.S. cities pipe geothermal hot water under roads and sidewalks to melt snow.

To produce geothermal-generated electricity, wells, sometimes a mile (1.6 kilometers) deep or more, are drilled into underground reservoirs to tap steam and very hot water that drive turbines linked to electricity generators. The first geothermal generated electricity was produced in Larderello, Italy, in 1904.

There are three types of geothermal power plants: dry steam, flash, and binary. Dry steam, the oldest geothermal technology, takes steam out of fractures in the ground and uses it to directly drive a turbine. Flash plants pull deep, high-pressure hot water into cooler, low-pressure water. The steam that results from this process is used to drive the turbine. In binary plants, the hot water is passed by a secondary fluid with a much lower boiling point than water. This causes the secondary fluid to turn to vapor, which then drives a turbine. Geothermal energy is generated in over 20 countries. The United States is the world's largest producer, and the largest geothermal development in the world is The Geysers north of San Francisco in California. In Iceland, many of the buildings and even swimming pools are heated with geothermal hot water. Iceland has at least 25 active volcanoes and many hot springs and geysers

Water (Hydropower): Hydropower is the largest renewable energy source for electricity generation in the United States. In 2015, hydropower accounted for about 6% of total U.S. electricity generation and 46% of electricity generation from all renewable. The source of hydroelectric power is water, because of this; hydroelectric power plants are usually located on or near a water source. The energy contained in running water can be turned into electricity. Water, which is impounded or held behind a dam, is released through a turbine that spins a generator producing electricity. When water is collected behind dams on large rivers, it provides a source of energy for the production of electricity. The enormous power of falling water is capable of turning giant turbines. These turbines drive the generators, which produce electricity. The degree of power is determined by the amount of water and the distance it falls. Hydroelectric power plants do not cause pollution, but there are fewer and fewer places to build dams. The environmental problem arises because a dam is typically built on a river creating a lake where land once stood. The advantages of hydropower is it is a clean source of energy and it does not create any waste byproducts. Also dams can shut their gates and conserve water for use when power is in higher demand

Wind: As the wind blows it spins the large blades on a wind turbine and generates electricity. The unequal heating of the earth's surface by the sun produces wind energy, which can be converted into mechanical and electrical energy. For a long time, the energy of wind has been to drive pumps. Today windmills can be connected to electric generators to turn the wind's motion energy into electrical energy, and wind over 8 miles per hour can be used to generate electricity. It is a renewable, but unpredictable, energy source.

Did you know that the wind you feel on your face when you play at the playground can be used to turn the lights on in schools that are miles and miles away? Wind can be used to make what is called energy, which can be turned into electricity. Electricity is used to turn on light bulbs, televisions, and even your computer at home! As long as the sun shines, there will be wind on the Earth. We will never run out of wind energy! This is because wind energy is renewable. Other advantages of wind energy is it is a clean energy source

Solar: Traditionally the sun has provided energy for practically all living on earth, through the process of photosynthesis, in which plants absorb solar radiation and convert it into stored energy for growth and development. The two main types of solar energy systems used today are photovoltaics and thermal systems. Photovoltaics systems convert solar radiation to electricity via silicon panels that generate light when the sun shines on it. Even though humans have been using the sun's energy for thousands of years, photovoltaic (solar-electric) technology is still very new, and sometimes it takes time for new things to catch on. The advantage of solar energy is it will not run out until the sun burns billions of years from now. The primary disadvantage of solar power is that it obviously cannot be created during the day. The power is also reduced during times of cloud coverage (although energy is still produced on a cloudy day).

Summary

The United States currently relies heavily on coal, oil, and natural gas for its energy. Fossil fuels are non-renewable, that is, they draw on finite resources that will eventually dwindle, becoming too expensive or too environmentally damaging to retrieve. In contrast, the many types of renewable energy resources-such as wind and solar energy-are constantly replenished and will never run out.

Most renewable energy comes either directly or indirectly from the sun. Sunlight, or solar energy, can be used directly for heating and lighting homes and other buildings, for generating electricity, and for hot water heating, solar cooling, and a variety of commercial and industrial uses.

The sun's heat also drives the wind, whose energy, is captured with wind turbines. Then, the winds and the sun's heat cause water to evaporate. When this water vapor turns

into rain or snow and flows downhill into rivers or streams, its energy can be captured using hydroelectric power.

Along with the rain and snow, sunlight causes plants to grow. The organic matter that makes up those plants is known as biomass. Biomass can be used to produce electricity, transportation fuels, or chemicals. The use of biomass for any of these purposes is called bioenergy.

Rationale

I have decided to build upon the ecosystem unit to help fill in the gaps that are important in understanding environmental concerns. Currently the fifth grade ecosystem unit does not address some common issues that impact the everyday lives of citizens. It is my belief that students should be empowered with all the necessary knowledge to help them become better citizens in our natural environment.

Second, as a district we are focusing on varying instruction that is closely related to differentiated instruction. We are working to develop all of our science lessons around the idea that all students learn differently, thus we are developing lessons and projects that allow students to have a variety of presentations and activities that focus on a wide range of learning abilities. All of the lessons developed will be focused around the student learning objectives and standards set forth The Next Generation Science Standards. Differentiated instruction can be defined as, “a process to approach teaching and learning for students of differing abilities in the same class, the intent of differentiating instruction is to maximize each student’s growth and individual success by meeting each student where he or she is, and assisting in the learning process”(Hall, 2002). The idea behind differentiated instruction not only allows for students to decide what is the best activity or project for themselves, but it allows the student to feel some sense of entitlement and control over how they learn.

In this inquiry based unit students will learn first-hand about nonrenewable and renewable energy sources, the advantages and disadvantages of the five most common renewable sources; they will be presented with a set of scenarios to consider on how their own personal life styles affect the world in which we live in. Finally students will design and present to their classmates a Lego model of the energy source they researched.

Learning Goal/ Lesson Objectives

In this Problem Based Learning (PBL) activity students will:

- Define renewable and non-renewable energy.
- Provide examples of common types of renewable and non-renewable energy resources.
- Understand and explain general ways to save energy at a personal, community and global level.
- Understand and explain, in general terms, solar heating /solar electric, hydropower, wind power geothermal and biomass work.
- Describe some general characteristics of solar power, hydropower, wind power, geothermal and biomass.
- Understand the benefits and disadvantages to using renewable energy resources.

Teaching Learning Model

Each activity in this unit has been selected for its renewable energy content and hands-on approach to motivating students. I recommend you read through the activities, choosing those that fit your own curriculum. It is very important to familiarize yourself with the background information on each renewable energy source.

Class Preparation

This lesson will be taught over seven days for 30 minutes each day. The last culminating activity is for students to present their Power point slide show, as well as showcase their model Lego project and create a renewable energy brochure.

Brainstorming: I will have students brainstorm ideas about where and when we use energy.

Energy- We use energy all the time. Humans use energy to be active – to walk, talk, play basketball, etc. We use energy to power our appliances, vehicles, lights, etc. Cells use energy to perform the most basic life functions. Life as we know it would not be possible without energy production and consumption. Energy is everywhere! Although sometimes you can hear energy (sound), feel energy (wind), and see energy (light), most often it is hard to figure out exactly where energy is and how it is flowing.

Energy can flow from one body to another and change forms, but it cannot be destroyed. Every form of energy can be converted into other forms. It is similar to the heat you feel coming off a light bulb while it is on. The warmth the product of electric energy that has been converted to heat energy. Whatever form it is in, energy is essentially the ability for making something happen or, as scientists put it, "doing work."

Where do we get our energy? Well, a lot of the energy we use originally comes from the sun. We get some energy directly from the sun when we use solar panels; however, most energy comes from fossil fuels (coal and oil), which derived their energy content from fossilized plants and other organisms that obtained their energy directly from the sun by a process called *photosynthesis* that occurred millions of years ago. There are many different types of energy, as we brainstormed earlier. Some of these types of energy are called *renewable*, or can be re-used, such as energy from the sun, wind or water. Other energy is called non-renewable because once it is used up; it is gone, like coal and oil.

Not all renewable energy resources come from the sun. Geothermal energy taps the Earth's internal heat for a variety of uses, including electric power production, and the heating and cooling of buildings.

Subject Areas Covered

Science – The entire unit is based around inquiry based science and scientific thinking processes that involve hands-on investigations and discovering explanations. The students use this process to learn about energy and the factors that relate to the importance of renewable energy.

Language Arts- Students will journal their discoveries, create brochures describing the importance of renewable energy.

Technology-Students will utilize technology throughout this unit, with I pads and create collages and further investigate renewable energy. They will be involved with lessons on the Smart board and will be immersed in Lego renewable kits creating models.

Description and Teaching Materials

In this unit students are introduced to the five types of renewable energy resources by engaging in various activities to help them understand the transformation of energy

(solar, water and wind) into electricity. Students explore the different roles engineers who work in renewable energy fields have in creating a sustainable environment – an environment that contributes to greater health, happiness and safety.

Future Timeline: Students will work in a group to imagine what today would be like if there were no electricity (permanently, not just a blackout situation). They will develop a timeline describing what this typical day might be like. They must really consider how they would feel and what they would do. Each group will present their timeline to the class.

Venn diagram: Students will create a Venn diagram to compare/contrast a form of renewable energy and a form of non-renewable energy. They should provide as many facts and details as they can.

Homework:

Save a Watt: Students will engage in two energy saving activities. They will describe in detail the impact these actions had during the next class. Students list the activities or write a paragraph and turn the assignment in.

Activity One: What is Energy?

1. ***Introduction:*** I will show my students a power point slide show of windmills, and solar panels to generate ideas. I will then ask the class: What do they think energy is? The class will then participate in a class discussion of student ideas and opinions related to energy conserving efforts and how it could impact their school experiences and life.

Class Discussion: (Pose the following Questions to the class): 1. How do we know the energy is there? (Answer: We can see it, feel it, hear it, etc.) 2. Describe where this energy comes from?

Small Group: Students will participate in a pair share activity to discuss the above questions for five minutes. Then we will have a discussion about the ideas they shared with their elbow partner.

Activity Two: Exploring Alternative Energy

I will present students with the following scenario:

In a year when Americans experienced record high prices at the gas pumps and winter heating costs are projected to soar nearly fifty percent, consumers are looking for ways to lower their energy costs for businesses, homes, schools, and transportation. Our primary energy sources today are fossil fuels, which are being depleted at an alarming rate.

According to some, if consumption continues at the current rate, the fossil fuel supply could be gone before the end of the century. In addition to the cost and supply issues, scientists have long warned of the environmental damage caused by burning fossil fuels. In short, we are at a crossroads. Americans must use and develop alternate forms of energy to help us power our homes, automobiles, and businesses into the future without destroying the Earth's environment. Exploring the use of renewable and alternative resources is a must in today's world.

Procedure -I will ask the students to think and discuss with their group members the following question

1. How would you feel if you were no longer able to go on school field trips or participate in extracurricular activities because of the high cost of transportation to and from these events?
2. How would you feel about having a longer school day, attending for an additional 1-2 hours each day so that the school would only have to be open four days each week?
3. How do you think your learning would be affected if you were in a classroom that was only heated to 60 or 65 degrees?

Students will discuss ways they can be actively involved in cutting their own energy consumption. Each student should create a chart describing what he/she is doing to conserve energy and show how much energy they are saving each day or week by changing their behavior and usage patterns.

Activity Three: Research Study

Whole Group: Today my students will pull an energy source out of a beaker indicating their renewable energy group. Students will be given an iPad / chart paper to research and answer the following specific questions.

- A. Research solar energy and how it can be used to power homes, schools, and businesses. Include an explanation of the science that explains how solar energy is collected and used to generate power.
- B. Research wind power and how it can be used in homes, schools, and businesses. Include an explanation of the science that explains how wind power is used to generate power.
- C. Research hydropower and how it can be used as energy for homes, schools, and businesses. Include an explanation of the science that explains how hydropower is used to generate power.

E. Research biomass and how it can be used as an alternate energy form. Include an explanation of the science that explains how biomass is collected and used to generate power.

F. Research geothermal energy and how it can be used as an alternate energy form. Include an explanation of the science that explains how geothermal energy is used to generate power.

Activity Four: Renewable and Nonrenewable Energy

I will refer back to the Activity One power point slide show of renewable energy sources wind, solar, biomass, geothermal and hydropower.

1. *Small Group* Each student will create a two-part collage, the first part representing what they knew and the second part representing what they learned from others in the group.

Activity four: Harness Energy

Whole Group: My students will view a video created by the US Department of Energy. In this video, former President Barack Obama wants our country to fund alternative energy research and alternative energy production. ? Video: <https://youtu.be/9PXHNF7aNWU>

Class Discussion: (I will pose the following Questions to the class) 1. Why do the people in this video say it is so important for us to find new and cleaner ways to generate energy? 2: Based on what you heard in this video, why do you think it is so important for our country to find advances in alternative energy?

Activity Four: Energy Web Quest

Whole Group: Using their iPad students will go to the Eco Kids website and answer the following question: 1.What are the five main types of renewable energy? Website: https://ecokids.ca/pub/eco_info/topics/renewable_energy/index.cfm#description

Small Group: Based on what the students heard in the video they will create a Venn diagram comparing and contrasting the positive benefits as well as potential negative consequences of renewable energy adoption.

Activity Five: Building our Renewable Energy Sources

LEGO Building • Making it better • How it works on the big scale

Build working LEGO models of renewable energy sources.

Small Groups: Each renewable energy group will be given a Lego energy kit, to begin building and designing their model. (If your school does not purchase Lego energy kits, students can still use regular Lego's to represent their energy source).

Activity Six: Packaging it all Up

Small Groups: I will have my students use all of their information from the unit to create and design brochures which advertise their form of energy. Based on Activity 5, students will utilize the key facts and details to create a brochure.

Activity Seven-Showcase Time

Whole class -All five renewable energy groups will present their Lego project and brochure to classmates. This activity may take longer than one class period.

Next Generation Science Standards

5-ESS3 Earth and Human Activity

Students who demonstrate understanding can: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3– 5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. □ Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1).

Disciplinary Core Ideas

ESS3.C: Human Impacts on Earth Systems □ Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1).

Crosscutting Concepts

Common Core State Standards Connections: ELA/Literacy – RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5 - ESS3 - 1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.(5-ESS3-1).

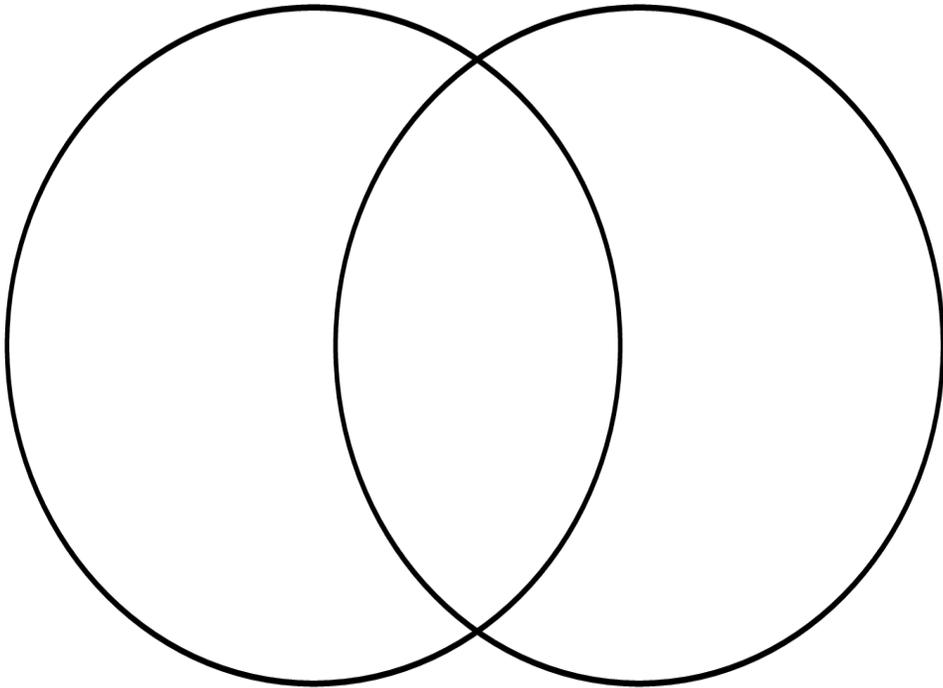
Appendix 1

Definition of Key Terms

1. Nonrenewable energy - existing in finite quantity; not capable of being replenished
2. **Renewable energy** is energy that is collected from **renewable** resources, which are naturally replenished on a human timescale.
3. Alternative energy- any **energy** source that is an **alternative** to fossil fuel.
4. Sustainable- pertaining to a system that maintains its own viability by using techniques that allow for continual reuse.
5. Biomass- *Energy*. organic matter, especially plant matter, that can be converted to fuel and is therefore regarded as a potential energy source.
6. Solar- energy derived from the sun in the form of solar radiation.
7. Hydropower- a form of energy generated by the conversion of free-falling water to electricity; the generation of electricity by using the motive power of water.
8. Geothermal - relating to the heat in the interior of the earth.
9. Wind - power derived from wind: used to generate electricity or mechanical power

Appendix 2

Venn Diagram



Appendix 3

Guided Student Research Questions

<p>Biomass- How can biomass be used as an alternate energy form. Include an explanation of the science that explains how biomass is collected and used to generate power.</p>	<p>Wind power - How can it be used in homes, schools, and businesses. Include an explanation of the science that explains how wind power is used to generate power.</p>
<p>Hydropower - How can it be used as energy for homes, schools, and businesses. Include a explanation of the science that explains how hydropower is used to generate power.</p>	<p>Geothermal- How can it be used as an alternate energy form. Include an explanation of the science that explains how geothermal energy is used to generate power.</p>
<p>Solar-How can it be used as energy for homes, schools, and businesses. Include a explanation of how the science that explains how solar energy is used to generate power.</p>	

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