Energy All Around Us

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This curriculum unit is recommended for:
(Science/Grades 3-5)

Keywords: Energy, transfer, static electricity, conduction, convection, radiation, work

Teaching Standards: See Appendix 5 for teaching standards addressed in this unit.

Synopsis:

Children love asking questions, especially when it relates to science. Our world is full of information and questions that are just waiting to be answered. This unit will help students tap into their own natural curiosity about energy in a fun and exciting way! This unit will explore various forms of energy and how it is stored and transferred from one form to another. Background information for this unit covers forms of heat transfer including convection, conduction and radiation. Scientific concepts also cover energy basics and how we use energy every day. To answer inquisitive and critical questions from our students and world, it is important to have a good understanding of what energy is in general. Our students are the future and the knowledge they receive will determine how they impact and change the world. The future rests in their hands and it is important that they have all the tools and knowledge necessary to make effective decisions for the global economy. One day they may be able to solve and explain life's critical questions that scientists have researched for years.

I plan to teach this unit during the coming year in to 22 students in Science/Grade 3.

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Miesha Brayboy Gadsden

Introduction

Do you think we will ever run out of oil? What do you think is the most effective form of energy? Questions such as these have been debatable questions in our society for years and the real truth still remains up in the air to several environmentalists. Since the beginning of the twenty-first century, fear and anxiety has loomed over if and when the world will run out of oil. Those who fear our oil shortage such as Marion Hubert believe strongly in a theory called the "Peak-Oil" theory, which states the oil supply will eventually plateau and their will be no future production of oil.[1] However, advocates believe that oil supplies continue to grow around the world and new discoveries will be significant enough to replace any possible threat of oil shortage. If we do run out of oil, what would be alternate forms of energy? What are the pros and cons of each energy source? To answer these critical questions, it is important to have a good understanding of what energy is in general. Our students are the future and the knowledge they receive will determine how they impact and change the world. The future rests in their hands and it is important that they have all the tools and knowledge necessary to make effective decisions for the global economy. One day they may be able to solve and explain life's critical questions that scientists have researched for years.

This unit will explore various forms of energy and how it is stored and transferred from one form to another. Scientists have used research to investigate areas of the world where certain alternate energy forms work better. For example, areas in the Midwest receive more wind than in other parts of the U.S. and would therefore benefit from using wind energy as an alternate energy source. North Carolina is not considered an area of high, strong winds so relying solely on wind energy would not be in our best interest.

On a recent field trip to a science center, my students were very inquisitive about new solar panels that lined the building and streets. This prompted research in our classroom about solar energy and how it is used as an alternate energy source. Through our class research, I discovered my students had even more questions about energy and some students had no idea what energy was at all. Their main reference for defining energy was hearing their parents say "You have a lot of energy!" Their inquisitive nature fits perfectly with our school IB philosophy of inquiry.

I teach 3rd grade students in a suburban school serving students K-5. This unit is intended for 3rd grade but can be adapted and modified for students in grades 4 and 5 as well. The school is located in the heart of a historic neighborhood as part of the Charlotte-Mecklenburg School System. Our school received its hallmark distinction as being an International Baccalaureate School in 2008. As part of our IB program, students develop questions and use research skills

such as the Scientific Method to answer their questions. Each student has an IB portfolio to document their growth and performance as they move from grade to grade. The school has a diverse population of 565 students. Within our subgroups, our student background is 30% African American, 48% White, 12% Hispanic, 7% Multi-Racial, and 3% Asian.

Our school serves students with physical, emotional and mental special needs as part of our Inclusion program. Students also have opportunities for enrichment through our Talent and Development Program, English as a Second Language Program, Girls on the Run, Student Government, Odyssey of the Mind and Chess Club. This school has been an integral part of our community and school system for more than 50 years.

Our PTO involvement is very high within the school as parents volunteer both their time and monetary gifts. Currently each 3rd, 4th and 5th grade classroom has a SMART board and the goal for PTO is to have each classroom equipped with this essential resource. Having a SMART board enables me to display daily content and gives opportunities for student interaction.

Through the IB program, Lansdowne also participates in several service projects to help the community and demonstrate positive examples of helping others. Lansdowne also initiated a Gardening Project with the help of our PTO. Students have an opportunity to plant, harvest and grow crops such as green beans, onions, lettuce, spinach and much more. Once students harvest the vegetables, they are taken to the Second Harvest Food Bank to give to those in need. What a great way to use hands-on learning and caring hearts to better the community!

The Discovery and Rationale

Children love asking questions, especially when it relates to science. Our world is full of science and questions that are just waiting to be answered. *Why is the sky blue? Why do engines need oil? Why do bees buzz?* Students can come up with questions for hours and hours by simply looking at the wonders of nature. This unit will help students tap into their own natural curiosity about energy in a fun and exciting way! We will explore three main topics: energy basics, energy storage and energy transfer.

Energy is a very abstract concept to teach to younger students and I want to use this unit to give students a basic understanding and foundation of science that they can use to help them in the future. I want students to understand that energy is all around us and can be seen in various forms such as static energy, hydroelectric energy, heat/thermal energy, light energy, etc. To do this, they must first understand that energy has two basic types: Kinetic and Potential. Because these terms are not familiar to most 7-8 year olds, it is important to use the terms, but also break it down in ways that they will be able to understand.

Kinetic: **K**eep it **K**ickin'/ Keep it Moving
Potential: **P**laying **P**ossum/Put it at Rest

The overarching idea for this unit is to create experiments and activities centered on energy transfer and energy conservation. I want students to understand how energy moves from warmer objects to cooler objects. For example, when cooking spaghetti on the stove or boiling an egg, energy is being transferred from the heat in the coils to the items in the pot. We are able to

see the released energy in the form of steam. Also, when rubbing our hands against each other, we are transferring the energy from one hand to the other to produce heat.

The basis of this unit will be taught in three major sections with a culminating project at the end. The unit will kick off with examining students' prior knowledge on energy. Each year Duke Energy partners with the Children's Theater of Charlotte to present a skit where they introduce students to energy and show them ways they can conserve it. Following the skit, students will create an Energy Mural that describes the different forms of energy portrayed in the skit. They will also use Table Top Twitter to write down all the things they already know about energy. Another activity to stimulate prior knowledge is by having students sort energy pictures into various groups. Pictures of windmills, nuclear power plants, power lines, electrical sockets, solar panels and more can be used to rouse student prior knowledge about energy.

Once students' prior knowledge has been activated they are ready to move into the second phase of the unit-investigating different forms of energy and how it transfers to different forms. To simulate kinetic energy to heat energy students will engage in an Ice Cube Race. They will predict ways of melting an ice cube the fastest. They can use their hands, a lamp, flashlight, the window, a paper towel or any objects available in the classroom. They will record their total time for melting the ice cube and the class will decide which method was most successful. Other engagement activities for the second portion of this unit will include Energy Stations such as balloon rubbing, toy car race, yo-yo movement, hot and cold water and temperature sand dunes (detailed description can be found in the Classroom Activities section and the appendix).

The final portion of this unit will assess student understanding of topics taught by having them participate in an Energy Expo. This event will require students to recreate and present one type of experiment they learned from the unit to a younger grade level in the gym. Students will set up their experiments similar to a Science Fair and younger students will rotate around to learn more about each station.

The Goals and Objectives

This unit will target 2 main science goals, math goals, and reading goals for students in grade 3. In the first science goal, *students will recognize how energy can be transferred from one object to another.*

- *3.P.3.1 Recognize that energy can be transferred from one object to another by rubbing them against each other.*
- *3.P.3.2 Recognize that energy can be transferred from a warmer object to a cooler one by contact or at a distance and the cooler object gets warmer.*

With this goal, I plan to use energy activities that show how friction is created and how convection and conduction occur in everyday objects. For example, when sticks are rubbed together to start campfires, energy is being transferred from one object to another to create the heat. As movement of the sticks gets faster and faster, the molecules move faster and faster and eventually there is enough energy to cause combustion of the wood or leaves, creating sparks of fire. Students will have opportunities to practice this by rubbing their hands together as well as

rubbing balloons against their heads to demonstrate static electricity. Students will gain further understanding of how energy from the Sun is radiated on Earth to warm the land, water and air by conducting research on the Sun and its role in our Solar System.

This unit will also target Math goals using the Common Core State Standards and Mathematical Practices.

- *Make sense of problems and persevere in solving them*
- *Construct viable arguments and critique the reasoning of others.*

Science and math are closely related and students will have several opportunities throughout this unit to relate energy to graphing, measurement, and basic arithmetic properties. For example, when comparing temperature of objects based on colors, students will use their math skills to read thermometers, interpret and graph data and figure out differences using math equations. Students will place thermometers in 2 separate boxes. One box will be covered in black construction paper while the other is covered in white construction paper. They will observe changes in temperature and create a viable argument/explanation of how the heat was transferred through radiation. *How much did the temperature change? Which object absorbed more heat? The object with black paper or the object with white paper? What happened to the temperature at each 5 minute interval? How can we show that on a graph?* Other variations in objects can also be used to track temperature changes such as using sand or dirt. Students will use 2 containers of either sand or dirt to get a constant temperature. Then they will shake one of the containers very vigorously and measure the temperature after the shake. *Did the temperature increase or decrease? What could be the cause of the temperature change?*

Reading is a fundamental portion of academic development and what better way to immerse students in science than by connecting it to content rich text! With reading goals, students will ask and answer questions to demonstrate understanding of a text referring explicitly to the text as the basis for the answers (CCSS.ELA-Literacy.RL.3.1). Students will also explain how specific aspects of a text's illustrations contribute to what is conveyed by the words in a story (*CCSS.ELA-Literacy.RL.3.7). By showing students pictures of common objects and activities using heat, students will explain the scientific reasoning behind each picture. For example, when showing students a picture of eggs boiling on a stove, they should be able to explain how heat is being transferred from one object to another. When showing them a picture of campers standing around a campfire, they should be able to explain how heat radiates from the fire to their fingers to warm them. Foundational skills from reading will also be incorporated by decoding words with common Latin suffixes and decoding multisyllable words.

Scientific Background for Teachers

To start this unit, it is critical for students to understand what energy actually is. Begin by asking them their thoughts and predictions on energy and have them write how it is used every day. Use their predictions as a pre-assessment so that students can compare their thinking from the beginning of this unit to the end. We use energy to do work. *Energy lights our cities. Energy powers our vehicles, trains, planes and rockets. Energy warms our homes, cooks our food, plays our music, gives us pictures on television. Energy powers machinery in factories and tractors on*

a farm.[ii] A wonderful book to help explain this concept to students is “Living Sunlight” by Molly Bang. Everything we do requires energy. For example, when we eat, our bodies transform the energy stored in the food into energy to do work. When we run or walk, we "burn" food energy in our bodies. When we think or read or write, we are also doing work. Cars, planes, light bulbs, boats and machinery also transform energy into work. Work means moving something, lifting something, warming something, lighting something. All these are a few of the various types of work which leads us back to the main definition of energy: “**the ability to do work**.”

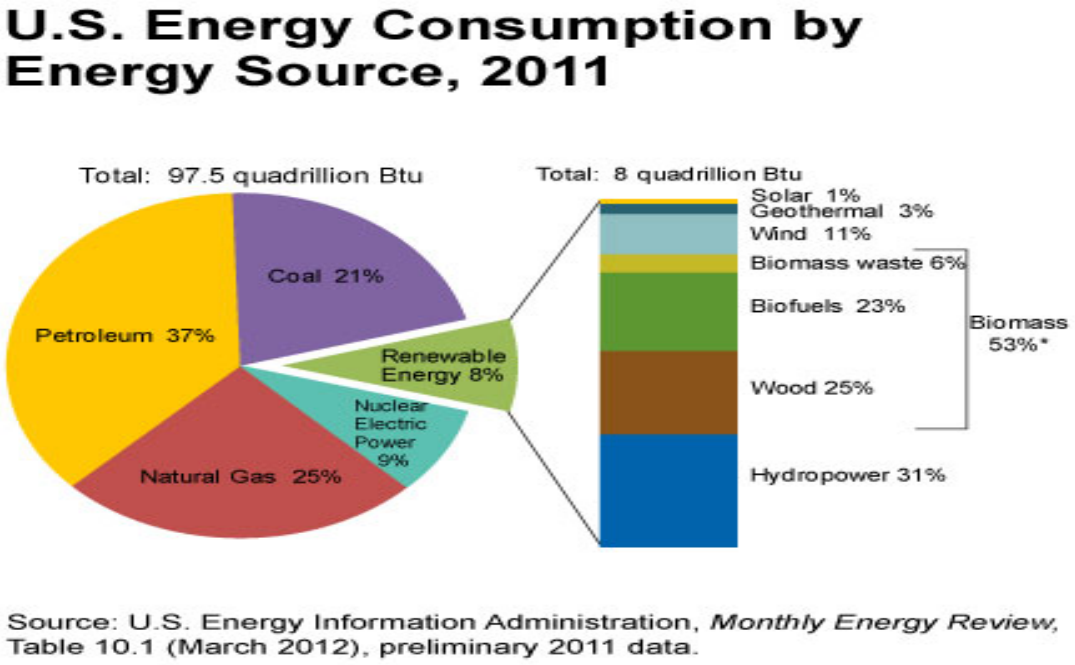
Another great strategy to use at the beginning of this unit is to start building a scientific word wall. There will be several new terms students encounter with energy and it is helpful for them to have a visible reference in the classroom. The word wall can start out with basic energy terms and as the unit progresses, more terms can be added to the word wall.

Vocabulary Word Wall

Renewable	Nonrenewable	Conservation	Nuclear
Electricity	Current	Fossil fuels	Conductor
Insulator	Kinetic	Potential	Temperature
Photovoltaic	Biofuel	Friction	Energy

A main portion of this unit includes identifying energy sources around the home and school. When we use electricity, it is typically generated by 3 major sources including coal, nuclear or hydroelectric power plants. Energy can also be classified into two major groups: Renewable and Nonrenewable Energy. Renewable Energy can include solar energy from the sun, wind, geothermal energy from heat inside the Earth, biomass from plants (which includes firewood from trees, ethanol from corn, and biodiesel from vegetable oil) and Hydropower from hydroturbines at a dam. [iii]

Nonrenewable energy includes fossil fuels such as oil, coal and natural gas. They are called fossil fuels because they were formed millions and millions of years ago. Below is a graph that shows differences between renewable and nonrenewable energy.



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 10.1 (March 2012), preliminary 2011 data.

Students can take a scavenger hunt around their classroom to see how power is generated (Refer to Appendix for pictures). Pictures are great ways for students to visualize how energy is all around us. Pictures such as a power plant, a dam, a power line, a windmill, a coal mine, etc. can be used. Then have students predict the main power source for the classroom. *Where do you think our power is generated?* Following their prediction, they will classify the pictures from the scavenger hunt into 2 groups: renewable or non-renewable and construct a bar graph. Students will explain their graph to their math partner and compare their data. This activity can also be extended by having students conduct the same type of scavenger hunt at home and create a graph of their results. *Do they use more renewable energy sources at home or at school?*

It is also important for students to understand the relationship between heat and light. Heat is transferred in 3 major forms including conduction, convection and radiation.

- **Conduction** occurs when energy is transferred from one molecule to another. As one atom or molecule is heated it begins to move more rapidly and it will pass some of its energy to the atoms and molecules around it. Through this process, all the molecules of an object pass energy from one to another. For example, if we used a metal skewer to roast marshmallows on a campfire, the fire heats the end of the metal skewer. Conduction will eventually transfer energy to the entire skewer making it too hot for us to hold.

- **Convection** is when energy is moved from one place to another by the bulk motion of a gas or liquid. Convection is common in both the atmosphere and oceans. Heated air in our atmosphere rises and cooler air rushes in to replace it. As the warm air rises, it cools and sinks back towards the Earth's surface. This sets up a circulation pattern of rising and falling air.

- **Radiation** is the emission of energy as electromagnetic waves (light) from objects. For example, when you stand in front of a camp fire holding your cold fingertips out in front

of you, what do you feel? Your fingers begin to warm up as they absorb the **radiation** coming from the fire. The infrared light leaves the hot fire, and radiates out towards your hands.[iv]

Energy is in everything. We use energy for everything we do, from making a jump shot to baking cookies to sending astronauts into space.[v]

Insulators and Conductors

Some materials are good thermal conductors, easily letting heat pass through them, while others are good thermal insulators, not easily letting heat pass through them. To help students understand this, we will use a variety of experiments to simulate this (Refer to Activities Section). When we know which materials are insulators and conductors, we can make the best choice when dressing for the weather and for keeping our food warm or cool. Electrical conductors are comprised of materials where electricity can flow freely through it such as copper, aluminum, gold, silver and platinum. Insulators are the opposite of conductors and prevent or block the flow of electricity. Common forms of insulators include: glass, porcelain, plastic and rubber.

How Energy is Generated

After students have a chance to complete their Scavenger Sort and graph, they will take an in depth look at the different ways we use energy and how it is generated.

- **Wind Energy**

Wind is caused when the Sun warms the land and water at different rates. Since the Earth is made of different types of land and water, it is heated unevenly and results in wind. To simulate wind energy, have students participate in a Wind Race. They will work in pairs to see who can move their object from one end of the race line to the other by blowing in a straw. To demonstrate how energy is stored and transferred students will use a storage battery and wind kit. They will attach alligator clips to the correct ends of a battery cell. Close supervision is needed for this, especially with younger students. Then students will use their hands to wind the handle on the back of the wind kit. This generation of mechanical energy will then be stored in the battery for later use. Once enough energy has been stored in the battery, the alligator clips can be released and the fan should be able to spin on its own. *What happened to the stored energy?*

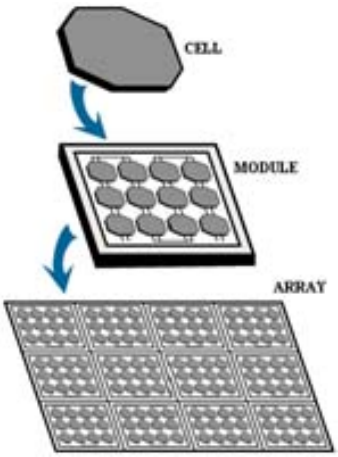
- **Nuclear Energy**

Most nuclear plants use uranium for fuel because its atoms are able to split apart very easily. Uranium is a non-renewable resource but is a common metal found in rocks around the world. To demonstrate the splitting of atoms, give each pair of students a chocolate chip cookie. Nuclear power plants use fission to make electricity. By splitting **uranium** atoms into two smaller atoms, the extra energy is released as heat. Uranium is a mineral rock, a very dense metal, that is found in the ground and is non-renewable, that means we can't make more. It is a cheap and plentiful fuel source. Power plants use the heat given off during fission as fuel to make electricity. [vi] Students will take the chocolate chip cookie and break it in half. The tiny broken crumbs that result from the breakage will represent the “energy” given off. They will then take

the half pieces and break them in half again. They should have even more crumbs on their paper towel to represent the "energy" given off. This energy or heat that is given off during fission is what is used to power nuclear plants.

- **Hydro Electric Energy**

For hundreds of years, moving water was used to turn wooden wheels that were attached to grinding wheels to grind (or mill) flour or corn. These were called grist mills or water mills. Today the same strategy of moving water is used to make electricity. Hydro-electric power uses the kinetic energy of moving water to make electricity. Hydro is one of the largest producers of electricity in the United States. Water power supplies about 10 percent of the entire electricity that we use. In states with high mountains and lots of rivers, even more electricity if made by hydro power. In California, for example, about 15 percent of all the electricity comes from hydroelectric.[vii]



- **Solar Energy**

The Sun is our nearest star and is the reason life exists on this planet. We use the Sun's energy every day in lots of different ways. The sun's heat can be used to dry our clothes and the sun's light can be used by plants to make food. We can change the sunlight directly to electricity using solar cells. When sunlight strikes the solar cell, electrons are knocked loose. They move toward the treated front surface. An electron imbalance is created between the front and back. When the two surfaces are joined by a connector, like a wire, a current of electricity occurs between the negative and positive sides. Electrical energy from solar cells can be used directly or stored in batteries. To simulate this process, it would be great to have an actual model of a solar cell and a solar kit to see how energy is stored within the battery.

Teaching Strategies

For this unit, I would like to arrange students in a variety of ways from independent reflection to small group collaborations. Several activities and experiments require students to work with a lab partner. Prior to this unit is it beneficial for students to work with several different partners to increase their cooperation and communication skills.

5E Learning Cycle

The 5E Learning Cycle model is an additional strategy that most educators use in the classroom, especially with science. This is an Inquiry process where students are active learners in the learning process. The 5 stages are: Engage, Explore, Explain, Elaborate, and Evaluate. In the first stage, students are drawn into the lesson by discussing their prior knowledge of a subject or thinking of questions about the topic that they would like to explore. In the second stage of the learning cycle (explore), students participate in experiments and demonstrations that help spark their inquiry process. Notice with this type of model, teachers are seen more as facilitators rather than pouring out a wealth of knowledge. Teachers guide student thinking in the explain process

by asking students to think about the experiment and helping students form generalizations. The fourth and fifth steps of this process are critical because we want students to go further with their questions and develop or plan alternate explanations. They need to know how the topic they are exploring relates to their everyday lives and how they can apply it. Often teachers have students complete an experiment without having students evaluate or reflect upon their process. This leaves students thinking "now what?" "We completed an experiment, but why?" Therefore, it is essential that the Learning Process Model is carried out to the end.

Science Journals

One strategy to help students organize their thinking and keep track of their data is by using Science Journals. For Science Journals to be most effective, students should set them up at the beginning of the year. The first page of their journal can be dedicated to science they already know from previous grades as well as their own interpretation of what they think a scientist looks like. Journals are powerful tools that allow students to record key vocabulary terms studied throughout the year as well as making pictures and diagrams of demonstrations and experiments.

Socratic Seminars

Another arrangement for this unit includes the use of Socratic Seminars. They will be used at the end of the unit to allow all students to showcase their knowledge and learn from others in the group. This strategy is a common method used in education to help students investigate multiple perspectives. Elfie Israel describes it beautifully by saying:

The Socratic seminar is a formal discussion, based on a text, in which the leader asks open-ended questions. Within the context of the discussion, students listen closely to the comments of others, thinking critically for themselves, and articulate their own thoughts and their responses to the thoughts of others. They learn to work cooperatively and to question intelligently and civilly.[viii]

Mock Debates

Mock Debates is another strategy that will be used in this unit to expose students to differing viewpoints and allow them to become more open minded in their decision making. With this teaching strategy, students will have an opportunity to look at pros and cons of a debatable topic and begin to brainstorm their own personal perspective. They then have opportunities to work in small groups that have the same perspective before presenting their side to the entire class. Before using this strategy, it is important to set a warm, comfortable environment where students feel comfortable expressing their ideas even if they are different. The whole group should agree on at least 3-5 "ground rules" to keep order and respect in the classroom. In this unit, students will have an opportunity to use Mock Debates when they defend their position on the best type of insulator or conductor for cooking or clothing in various weather conditions. To simulate this experiment, use a refrigerated soda can and brainstorm various insulators to keep the object cool such as: plastic, aluminum foil, cardboard, felt and Styrofoam. Students will research and choose a side for the best insulator giving supporting reasons.

Table Top Twitter

As we become more and more technologically advanced, twitter is a great way to share opinions and ideas in a quick way. To simulate twitter in the classroom, students will use Table Top Twitter to express their ideas. To set this up, teachers will need large sheets of construction paper or chart paper. They will write one idea in the center of the poster and students will rotate around the charts to write down their thoughts and ideas. Their thoughts should be clear and short and should reflect their own thinking. For example, if the topic is Wind Energy, they will draw and write ways wind energy is used around the world and the pros and cons of using wind. They can also use this opportunity to comment on their classmates' ideas. Our school recently received an iPad cart where we have access to 25 iPads. This will also give us a chance to use the iPads to blog and do Table Top Twitter.

Classroom Activities

Energy Lab Stations

Students will have an opportunity to work with their lab partner and complete four energy rotation centers (Ice Cube Race, Sand Dune Shake, Flashlight Generator and Solar Panel Storage Cell). They will use a rubric to assess themselves on their participation and knowledge gained at each station. They will also use an energy science brochure to record their diagrams and information. Predictions will be made prior to each station and students will confirm their predictions following the experiment.

Station 1 will need ice cubes for each student, paper towels, paper cups, stopwatch and common classroom objects (flashlight, overhead, window, etc).Before passing out the ice cubes, instruct lab partners that their goal is to see which group can melt an ice cube the fastest. They may use any objects around the classroom but the teacher should let students make reasonable predictions instead of telling them which objects to use. Partner A will set the stopwatch to record the time it takes for Partner B to melt the ice cube. On the recording sheet students will write their prediction, the object they used to melt the ice cube, how long it took them and what changed as a result. Partners will switch roles and now Partner A will have a chance to melt the ice cube. Guiding questions: *What caused your ice cube to melt? Once energy was applied to your object, what happened as a result?*

Station 2 is the Sand Dune Shake and will require plastic cups with lids, sand and thermometers. The objective of this station is to investigate what happens to the temperature of objects when they are shaken. Students will pour sand into 2 plastic containers. They will measure the temperature of each container and record on their lab sheet. Then they will shake one of the sand containers and measure the temperature of the sand. *Did the temperature increase or decrease?*

Station 3 will require the use of a hand generated flashlight. A hand generated flashlight works by converting motion into electrical energy. Students will first predict whether electrical energy can be produced manually. Then they will predict how long the flashlight will stay on

once they crank or turn the handle. *What happens?* Electricity is powering the light and charging the capacitor or battery to use when not shaking. Inside of the flashlight is a stationary coil of wire, there is also one magnet that passes through the coil of wire when the flashlight is gently shaken, this magnet is called the "charging" magnet. As the flashlight is shaken, electricity is generated as the charging magnet passes back and forth through the coil of wire. The electricity is stored in a capacitor or battery. When the flashlight is turned on, the capacitor or battery delivers electricity. The light will stay on as long as the capacitor or battery is charged.[ix]

Station 4 is the Solar Panel Storage Cell. For this station, please have several solar powered calculators available so that students can test how much light is needed to power them. Have them find objects around the classroom such as paper, boxes, cloth, books, their desk, bookbags, etc. to see if the light is able to pass through and allow the calculator to work. They will also need a real solar panel to look at and observe its components. They will attempt to recreate a solar panel using aluminum foil and boxes. To enhance their math skills with multiplication, they will build arrays that simulate a photovoltaic cell. For example, they will use the aluminum foil to create circles in rows and columns. One array might have 4 aluminums circles going across and 3 going down. Students will calculate the total number of solar cells on the entire array by making a multiplication equation. They will record their equations on butcher paper and sketch an example of their array. Guiding Questions: *What material do you think real solar cells are really made out of? How many do you think we would need to power the lights in our classroom?*

Activity 2: Animal Dream Homes—"The Best Insulator"

Students will have an opportunity to investigate various materials to see which one would be the best insulator. They will use household materials such as plastic, paper, Styrofoam, aluminum foil, cotton cloth, tissue paper, etc. Prior to this lesson, review animal habitats and environmental conditions. Students should have a solid foundation of animal habitats from 2nd grade. They will imagine they are building a home for an artic animal of their choice. As a whole group you can model creating a home for a penguin since they live in artic environmental conditions. *If we were to build a dream home for a penguin, which material would provide the best insulator to keep him warm?* Have students brainstorm a list of common materials found at home and school. Using the scientific method, students would then make predictions based off the materials from their list.

To test each item students will use ice cubes. The ice cubes will simulate the penguins or other artic animals. It is important to make sure all ice cubes are the same size for data accuracy. Students will work in lab partners to create a "home" using the selected material and place an ice cube in each home. They will record the time they start on their chart and make observations as how their ice cubes are melting. At the end of 30 minutes (or class selected time) students will observe which ice cube melted the least to determine if their home was the best insulator. If all portions of the lab were set up well, students will discover Styrofoam kept their ice cube insulated more than any other material. Styrofoam is made of billions of gas bubbles which are spaced apart. Gases prevent large quantities of heat transfer because the molecules are spaced so far apart which don't allow them to collide with each other. When molecules collide, it creates a transfer of heat/energy. Have students think about what type of cups their drinks come in when

they order them from a fast food restaurant or get a drink to go. They can test this out at home too simply by comparing the cups from restaurants and leaving them in the car for an hour. When they return, have them ask themselves: *Which drink is the coolest? What is the cup made out of?*

Activity 3: You're In Hot Water: Heat Transfer through Liquids

Before setting up this activity, pose a question for students to answer with their lab partners. *Can heat move? Why or Why not? How does the Sun warm the Earth?* Then have students create a graphic organizer in their science notebooks to define the three main types of heat transfer: convection, conduction, radiation.

Vocabulary Chart

Convection	Transferring heat in the form of water currents or gas currents	Examples: Boiling Water, Ocean Currents
Conduction	Transferring heat from one object to another or one molecule to another	Examples: insulators and conductors
Radiation	Heat from the Sun travels to the Earth in the form of electromagnetic rays.	Examples: UV rays

For this teacher demonstration you will need a shallow glass dish, food coloring, water, portable heat source or small burner, glitter and oven mitts. **Please be sure to follow all safety precautions when working with the burner and water. Students will also record their observations in their science notebooks. To prepare the area, place the small burner on a fireproof surface and add water to the shallow glass dish. Have a student volunteer record the temperature of the water before heating the burner. All students will record the initial temperature in their science notebooks. The burner should be right underneath the shallow dish. Add food coloring of choice to the water so the students will be able to see. Sprinkle glitter in the center of the dish, preferably right above the heat source. Students will record what happens to the glitter when the water is heated in their science notebooks. Use an additional student to record the final temperature once the water is heated and compare it with the initial temperature. *What direction does the water travel? Does heat move? How do you know?*

The glitter should travel from the center where it is initially heated with the water to the outer edges. Students should be able to see how warm water travels to cooler water in the form of convection. At the end of the demonstration, review the three different ways heat travels and have students make diagrams in their notebooks describing and illustrating those three ways.

Culminating Activity: Energy Expo

At the end of this unit, students will have an opportunity to share their knowledge with other students in the school. They will become the "experts" and design a simulation of one of the experiments used from the unit. They can also create their own as long as it pertains to energy basics or energy transfer. Previous experiments and activities that students can choose from include: Energy Sort, Ice Cube Race, Balloon Rubbing, Toy Cars, Temperature Boxes, Sand Dune Shake, You're in Hot Water and much more! They will create their simulation; explain what energy is present and what they learned from the experiment. Students at our school have partnerships with Kindergarten Reading Buddies where they meet together once a week. They will teach and share their energy simulation with their reading buddy. If your school has similar partnerships, this method can also be used. Otherwise other options include teaching to younger grade levels or using the gym to set the simulations up as a museum. This will allow everyone to walk through and visit each station as students explain or "transfer" their designs to their visitors.

Energy is all around us from our cars to our schools to our bodies. Exposing students to a wide variety of information gives them a springboard to their own natural curiosity in asking questions. They are our future and the knowledge we impart to them can be shared and ***transferred*** to others. It is like a domino effect. Teachers are like the facilitators to help get the movement started but it is truly the students that will take the information to a new level and change the world!

Resources

Bibliography for Teachers

"Insulator versus Conductor – TeacherTube." TeacherTube – Teach the World. http://www.teachertube.com/viewVideo.php?video_id=21925 (accessed September 26, 2013).

Video from teacher tube to teach students the differences between conductors and insulators.

"Kids Korner – Conductors and Insulators." Kids Korner – What's It All About?. http://www.fplsafetyworld.com/?ver=kkblue&utilid=fplforkids&id=16185 (accessed September 26, 2013).

Kid friendly website that explains basics of energy and how heat is transferred from one object to another. Includes a variety of experiments and activities for kids.

"Kids Korner – Energy Efficiency." Kids Korner – What's It All About?. http://www.fplsafetyworld.com/?ver=kkblue&utilid=fplforkids&id=16160 (accessed September 26, 2013).

Kid friendly website that includes teacher guide and coloring activities for younger kids to describe the basic foundations of energy.

"The Energy Story – Introduction." The Energy Story – Introduction. http://www.energyquest.ca.gov/story/ (accessed November 1, 2013).

This website is from California Energy Commission's energy and environmental education site. It is for students, parents and teachers and includes information, questions and answers about energy basics and the different forms of energy.

Reading List for Students

Bang, Molly, and Penny Chisholm. *Living sunlight: how plants bring the earth to life*. New York: Blue Sky Press, 2009. Print.

Bradley, Kimberly Brubaker, and Paul Meisel. *Energy makes things happen*. New York: HarperCollins, 2003. Print. In this book, you can find out all the ways you and everyone on earth need energy to make things happen.

Drummond, Allan. *Energy island: how one community harnessed the wind and changed their world*. New York: Farrar, Straus and Giroux, 2011. Print. A narrative tale and a science book in one, this inspiring true story proves that with a little hard work and a big idea, anyone can make a huge step towards energy conservation.

Green, Jen, and Mike Gordon. *Why should I save energy?*. Hauppauge, NY: Barrons Educational Series, Inc., 2005. Print. The enlightening and entertaining four-book Why Should I? series demonstrates the importance of protecting nature.

Sobey, Edwin J. C.. *Solar cell and renewable energy experiments*. Berkeley Heights, NJ: Enslow Publishers, 2011. Print. The projects in this book teach young readers about solar cells, electricity, and energy. Experiment with simple ways of using renewable energy to power different devices. Many experiments include ideas you can use for your own science fair projects.

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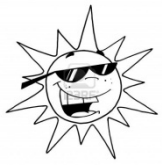
How is Energy Generated?

Sample Pictures

Miesha Gadsden

Appendix 2

Energy Centers



Prediction:	
What Happened	
What Did You Learn?	
What Caused the Change?	

Prediction:	
What Happened	
What Did You Learn?	
What Caused the Change?	

Appendix 3

Energy Centers Rubric

CATEGORY	4	3	2	1
Scientific Concepts	Chart illustrates an accurate and thorough understanding of scientific concepts underlying the centers.	Chart illustrates an accurate understanding of most scientific concepts underlying the centers.	Chart illustrates a limited understanding of scientific concepts underlying the centers.	Chart illustrates inaccurate understanding of scientific concepts underlying the centers.
Participation	Used time well in centers and focused attention on the experiment.	Used time pretty well. Stayed focused on the experiment most of the time.	Did the centers but did not appear very interested. Focus was lost on several occasions.	Participation was minimal OR student was uncooperative.
Summary	Summary describes the skills learned, the information learned and some future applications to real life situations.	Summary describes the information learned and a possible application to a real life situation.	Summary describes the information learned.	No summary is written.
Appearance/Organization	Lab report is typed and uses headings and subheadings to visually organize the material.	Lab report is neatly handwritten and uses headings and subheadings to visually organize the material.	Lab report is neatly written or typed, but formatting does not help visually organize the material.	Lab report is handwritten and looks sloppy with cross-outs, multiple erasures and/or tears and creases.

Name:_____ Total:_____

Appendix 4

Science Notebook

You're in Hot Water!
Heat Transfer through Liquids

Question: Do you think heat moves? Why or Why not? Discuss with your lab partner and record your thoughts.

_____
_____
_____

Water Demonstration
Record your temperature using Fahrenheit

Initial Temperature	Ending Temperature	Difference

Make a sketch of the demonstration before the water is heated.

Make a sketch of the demonstration after the water is heated. Describe what happens to the glitter.

Appendix 5
Implementing Common Core Standards

Science Goals

Students will recognize how energy can be transferred from one object to another.

- *3.P.3.1 Recognize that energy can be transferred from one object to another by rubbing them against each other.*
- *3.P.3.2 Recognize that energy can be transferred from a warmer object to a cooler one by contact or at a distance and the cooler object gets warmer.*

With this goal, I plan to use energy activities that show how friction is created and how convection and conduction occur in everyday objects. For example, when sticks are rubbed together to start campfires, energy is being transferred from one object to another to create the heat. As movement of the sticks gets faster and faster, the molecules move faster and faster and eventually there is enough energy to cause combustion of the wood or leaves, creating sparks of fire. Students will have opportunities to practice this by rubbing their hands together as well as rubbing balloons against their heads to demonstrate static electricity.

Math Goals

- *Make sense of problems and persevere in solving them*
- *Construct viable arguments and critique the reasoning of others.*

Science and math are closely related and students will have several opportunities throughout this unit to relate energy to graphing, measurement, and basic arithmetic properties. For example, when comparing temperature of objects based on colors, students will use their math skills to read thermometers, interpret and graph data and figure out differences using math equations. Students will place thermometers in 2 separate boxes. One box will be covered in black construction paper while the other is covered in white construction paper. They will observe changes in temperature and create a viable argument/explanation of how the heat was transferred through radiation. *How much did the temperature change? Which object absorbed more heat? The object with black paper or the object with white paper? What happened to the temperature at each 5 minute interval? How can we show that on a graph?* Other variations in objects can also be used to track temperature changes such as using sand or dirt. Students will use 2 containers of either sand or dirt to get a constant temperature. Then they will shake one of the containers very vigorously and measure the temperature after the shake. *Did the temperature increase or decrease? What could be the cause of the temperature change?*

Reading Goals

With reading goals, students will ask and answer questions to demonstrate understanding of a text referring explicitly to the text as the basis for the answers (CCSS.ELA-Literacy.RL.3.1). Students will also explain how specific aspects of a text's illustrations contribute to what is conveyed by the words in a story (*CCSS.ELA-Literacy.RL.3.7). By showing students pictures of common objects and activities using heat, students will explain the scientific reasoning behind each picture.

[i] The Quest by Daniel Yergin
[ii] Energy Quest
[iii] Energy for Kids
[iv] Geography for Kids (www.kidsgeo.com)
[v] Energy for Kids
[vivi] Kids Korner Apogee
[vii] The Energy Story Chapter 12
[viii] Examining Multiple Perspectives in Literature, Elfie Israel
[ix] NEED National Energy Education Development Project