Powering Up! : Researching Energy Choices

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This curriculum unit is recommended for:
Media & Information Skills Grades 4-5

Keywords: Energy, Fossil Fuels, Note-taking, The Big6

Teaching Standards: See Appendix 1 for local teaching standards addressed in this unit.

Synopsis: This unit was written to support homeroom instruction on the subject of energy for upper-elementary students by building background knowledge through hands-on and research activities in the Library Media Center during the span of an academic year. Because the topic is so vast, it cycles over and over in the curriculum, appearing in almost every grade-level in one form or another. Specific topics included in this unit are: Magnetism, Types of energy, Generation of electricity, Fossil fuels, Energy transfer, Alternative energy, and the effects of the sun on the Hydrologic Cycle. Note-taking will be taught using the Cornell method using print, webpages, electronic texts, animations and video recordings that link science content to real-world problems. As part of these note-taking exercises hypertext markup language (HTML) conventions will be learned and non-fiction conventions will be reviewed. Two techniques for forming essential questions will be introduced, Question Formulation Technique (QFT) and See, Clarify, Assess and Name (SCAN). We will review the Scientific Method and apply The Big 6 Research Method. All these activities are designed to reinforce classroom instruction. The research project is a student-led inquiry into a sub-topic of choice, while the experiments are directly related to science standards.

I plan to teach this unit during the academic year 2013-2014 to 224 students.

Powering up: Researching the choices

Deborah Yu-Yuk Jung

History is a race between education and catastrophe.
— H. G. Wells

Introduction

One of my favorite activities is swimming at dawn. In the lap pool, I am alone, moving in a silent meditation focused almost entirely on the breath. Slowly, the sunlight overwhelms the cold artificial light. As I swim through the ribbons of light that stream through the windows into the pool, they deepen from palest yellow to a bright lemon, reminding me that the sun is the source of life and light on the planet as well as the power source for all the technology on which I depend.

Our sun is the source of all energy, from wave energy in the ocean, to fossil fuels, to the food that fuels us. This curriculum unit is my attempt to connect real-word problems using the science content to provide opportunities for deepening understanding through reading and research in the Library Media Center. While this unit is intended for Media Specialists, many of these activities could be implemented in the classroom. The wonderful thing about the topic of Energy is that there are so many aspects to explore. Grade 4 has an entire unit based on Energy, and that is primarily what this curriculum unit will focus upon. I will use their unit on rocks and minerals to focus on the formation of fossil fuels. Students will be building background information through video streaming and an exploration of print and non-print text. Students will then synthesize the background knowledge in a research project. Finally, students will apply what they learned in an experiment. Grade 5 explores weather and energy transfer, both on the earth's system as well as within the food web, which gives us an opportunity to explore wind, solar and hydro power. A brief review of Science content is provided with each activity in the following section

The specific research skills I'll be covering will be note-taking, writing, asking questions, recording data objectively, finally, making inferences. Note-taking will be taught using the resource *Read, Write, Think.* We will review the Scientific Method and apply The Big 6 research method. Emphasis will be placed on following copyright law by crafting new and original sentences based on information gleaned in research to adhere to copyright law.

If indeed we are in entering our last century of petroleum fueled electricity production, the solution the planet needs may come from the flexible minds of students. It is my hope that exploring both through research as well as hands on activities will inspire students to go on to further explorations of topics that personally interest them.

Demographic Background

Winding Springs Elementary School is situated in a part of the city that was rural, but has gradually over the last twenty years become an inner-city school. What once was a poor rural area, has become a poor suburban area. Forth-nine percent of my students are Latino and forty-eight percent are African-American. Ninety-one percent of the students qualify for free or reduced meals. Few students have access to technology or the internet at home. The school serves three trailer parks as well as subsidized low-income housing. Many of our parents are illiterate in their native language. Over 50% of students live in households where no English is spoken, and so the students lag behind in reading, speaking and writing skills. My students overcome huge barriers to come to school every day--substandard housing, language, hunger, transportation, school supplies, just to name a few.

Cognitive lags, emotional and social problems are the effects most often noticed in a classroom setting, but they are not the only ones. Poor health and high stress also contribute to poor academic performance. For instance, low income neighborhoods not only have higher traffic volume and higher crime rate, but may also have fewer municipal amenities like green space, libraries and playgrounds, so there is less exposure to culturally enriching experiences. Chaotic living conditions cause the brain to develop adverse adaptive responses, which become evident in social interactions. The behaviors which disrupt the classroom, impulsive and impatient behaviors, inappropriate emotional responses and limited behavioral responses are a result of unstable early childhood relationships.[1] There seems to be a strong correlation between family income and early academic success[2]; affecting physical and mental health, social relationships and cognitive processes.

I teach 44 homeroom classes dispersed into 42 sections for grades K-5 in fixed schedule that includes a 20-minute period for checking out books, so the actual direct instruction time is 25 minutes once a week, perhaps less if the students are working on a guided activity. Often teaching has to be broken up into two or three week lessons, with the first being primarily direct instruction and the second, a lesson that features a quick review and a guided or independent activity, so the lessons in this curriculum unit will span more than one class period. Lessons that last more than 3 weeks lose their effectiveness—students become bored with the topic. One way to cope with the tight schedule is to have students log into computers and have a brief instruction or review period while the computers complete the login process. Another is to present the

material, then while students work at their tables, call small groups to check out books. Materials can also be laid out in advance, so students can independently review while books are checked out.

Rationale

Critical thinking, communication, collaboration and creativity are the skills we want our students to develop in order to work effectively. Developing patterns of investigation that embrace multiple perspectives is key to bridging cultural differences in this day and age. We want our students to develop skills that they can apply to new, real-world situations. School Libraries support students by teaching them to use sequential research processes, such as Big6. Using a metacognitive method that encourages self-assessment builds self-confidence, independent thinking and problem solving skills. The kind of research performed in an elementary school tends to be basic, but occasionally, there are opportunities to perform correlational, historical or applied research, which is what we want to see happen as students mature. While collaboration with a homeroom teacher may control the primary subject, there is usually enough latitude to allow students to select a sub-topic of interest and I strongly encourage students to do so. Ideally, any research would be driven by students' interest. This unit provides an opportunity for students to explore subtopics within the subject of energy, offering students an authentic research opportunity as well as practice in using newly acquired vocabulary through writing.

Because of the demographics of this school, building background knowledge is very important in supporting Science instruction in the classroom. Therefore, the information will be presented a number of times in different formats, using questioning techniques to help give the purpose to the reading[3] and to build comprehension. Assigning writing is also important, as writing provides an opportunity to use the newly acquired vocabulary in context. Furthermore, by expressing their thinking through the writing process, students clarify the ideas and concepts that have been taught. Requiring students to present in both graphic and written format requires students to review and "re-compose" the learned information. The skills involved in scientific research[4]: developing questions, making predictions, planning and conducting investigations, writing detailed observations, collecting and recording data, making inferences and comparisons, recognizing cause and effect relationships, analyzing data, and finally, constructing conclusions and explanations force students to apply what they have learned. Add to these the metacognitive practice of evaluating the process as well as the product and the project would support the skill development necessary for 21st century students.

Two research methods will be covered in Media classes, The Big6 and Scientific Method. What has become known as the Scientific Method has been in use for centuries, credited to ancient Sophists, as an organized way to observe the natural world.

The basic steps[5], in order, are: Observe, Perform research, Hypothesize, Test the theory, Analyze data, Draw a conclusion, and Communicate results. Big6 has six steps, which walk students through basic research from identifying the task, selecting resources, to evaluating both the project and the process. Note that in Big6 and Scientific Method, students are asked to develop a range of questions to frame their research. Creating questions that can be investigated is a necessary skill for students to master. The next step in Big6 would be to define the task, what exactly is the purpose and expected end-product of the research. The third step is to select resources appropriate for the project. I would like students to find appropriate resources using a variety of formats and be able to evaluate those resources for accuracy, validity and appropriateness. Students should be able to identify main ideas and supporting details, point of view and bias. As a teacher-librarian, I want students go beyond just a collection of superficial facts. Step four asks students to engage in and extract information, which is typical of any school project. Step five refers to the synthesis and organization of information. Finally, the last step asks students to evaluate the end-product and the process. The activities below are designed to support learning in the homeroom. Each teaching activity described below is preceded by the national standards, first The American Association of School Libraries 21st Century Learning Standards as well as The Next Generation Science Standards. Then the science vocabulary is provided, followed by the science content. Finally, the information skills lesson is presented. Local standards can be found in the appendix.

Teaching Activities

Magnetism| Activity: Building background, building a word bank.

AASL 1.3.3 Follow ethical and legal guidelines in gathering and using information.
4-PS3.A: Definitions of Energy

4th Grade Concepts*:* magnet, iron, metal, negative, force field, poles, electric charge, battery, path, pull, push, motion, bulb, attraction, repulsion, positive

Science Content: What is a magnet?

Much of our modern live depends upon magnets, but what are they? Atoms are composed of protons, neutrons and electrons. Protons and neutrons comprise the nucleus of an atom, while electrons surround the nucleus. Protons have a positive charge, while electrons have a negative charge. Neutrons are neutral. Electrons move in an orbit around the nucleus and they also have intrinsic angular momentum or what physicists call “spin”. Normally electrons are paired, which means the direction that each member of the paired electron spins, cancels out the effect of the other member. However, some elements have unpaired electrons and it is the odd electron that gives magnets their

unique property. In the solid state, these orbits are lined up in the same direction, giving the metal two distinct faces, a side that emits a force that repels and a side that attracts. So while there are natural magnets, we tend to use synthetic magnets, permanent, temporary and electro- in our gadgets. Permanent magnets, such as ceramic magnets, retain their magnetic properties once they are made. Temporary magnets, made of common metals, only retain the magnetic properties while in the presence of a strong magnet. For instance, paperclips become weak temporary magnets when connected with a permanent magnet, but once the permanent magnet is removed, the paperclips lose their magnetic properties. Electromagnets are created when a current flows through them, so while they are temporary and man-made, the magnetic properties are not directly caused by another magnet, but by electricity and so, are considered a separate category.[6]

Teaching Strategy: Pulling out the facts to create a word bank

Science content spirals around and around in elementary education, sometimes making it difficult to make connections with concepts in Special Area classes, unless the teacher is willing to engage students in reviewing background information. However, tapping background knowledge is essential in before moving on to new concepts, not just as a foundation to scaffold more information, but as a form of motivation. [7] There is a relationship between knowledge and the intrinsic motivation to learn; when a teacher can help a student access that background knowledge it encourages the student to learn.

This two- part lesson begins with a demonstration using *ReadWriteThink's "*Fact Fragment Frenzy", http://www.readwritethink.org/classroom-resources/student-interactives/fact-fragment-frenzy-30013.html. After modeling how to use this method with the entire group, students will practice this method by circling or highlighting key terms. Students will use passages from Discovery Education related to their studies on magnetism. After they finish locating key terms, students will build a word bank on an index card. When the word banks are complete, students will copy the article citation to the top of the notebook page and write new and original sentences using the key words to summarize their article. This activity not only teaches note-taking, but provides an opportunity for students to use the science vocabulary in context. Grade 5 is expected to cite their source as part of this lesson.

Energy Basics| Activity: Taking notes from web resources using HTML conventions

AASL .1.6 Organize personal knowledge in a way that can be called upon easily.
4-PS3.D: Energy in Chemical Processes and Everyday Life. The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. Energy can be transferred in various ways and between objects.

5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
5-PS3-1Energy can be transferred in various ways and between objects.

4th Grade Concepts: Energy, light, sound, heat, electrical, magnetic, motion, circuit, thermal, energy, transfer, light, medium, reflected, refracted, absorbed, wavelength, spectrum
5th Grade Concepts: conduction, convection, radiation, electromagnetic waves, thermal energy, convection cell, transfer

Science Content: Forms of energy

Later in the semester, both fourth and fifth grade students will be asked to provide evidence of the transfer of energy, so that a firm background understanding about energy needs to be built. To do that we will use a strategy that allows us to build background knowledge. As I stated earlier, we exist because of the bounty of the sun′s energy. All forms of energy we depend upon are derived from the light of the sun. Energy manifests in several forms on our planet: Gravitational, Radiant, Thermal, Motion, Sound, Electrical, Chemical, and Nuclear. Energy can be categorized as either stored (Potential) or in motion (Kinetic). Radiant energy is a kinetic form that manifests as visible light as well as gamma, radio and x-rays. Thermal energy or heat is another kinetic form that refers to the atomic or molecular movement within all matter. While both Sound and Motion also refer to movement, Motion involves the movement of mass, while Sound energy is specifically about the passage of energy through matter in a longitudinal wave. Gravitational energy a form of potential energy that is based on the attraction two masses has for each other. Other forms of potential energy include Chemical, Mechanical and Nuclear. Mechanical energy lies in the potential energy of objects held in tension. Chemical energy is potential energy that is released as thermal energy by when new molecules are formed as one substance is changed to another. While Nuclear energy's potential lies in the thermal energy released as nuclei of atoms are split.[8]

Teaching Strategy: Note-taking using the Cornell Method

This activity builds more background information, necessary for children of poverty, who may have missed this content earlier in their education. Cornell note-taking is a standard form which may be useful because it can be matched to HTML headings in a webpage as well as nonfiction conventions in traditional print media. It is also a good strategy for taking notes in a live lecture. Fossil fuel [9]energy will be the subject for Grade 4, while Heat energy will be the subject for Grade 5.

The Cornell Method, http://lsc.cornell.edu/LSC_Resources/cornellsystem.pdf, uses form that looks like a lopsided I-chart. Along the right side students take notes, using

phrases and illustrations to capture the main idea. Along the left margin, adjacent to each bulleted idea, the student writes the corresponding test questions, formulas or key-words. At the bottom, students will summarize what they heard or viewed in order to make the paired brain associations and retain the information.

The Cornell Method will be explained, then, it will be modeled by teacher using a site such as *Energy Basics* (http://www.eia.gov/kids/energy.cfm?page=about_home-basics) or *Energy Story* (http://www.energyquest.ca.gov/story/) for fourth graders. Fifth graders will begin this exercise with a review of the hydrologic cycle using "The Water Cycle", http://www.mbgnet.net/fresh/index.htm. Students will then set up their pages and as a whole group activity, we will examine the webpage, noting level 1, 2 and 3 hypertext markup language headings (HTML) which indicate the main topic, subtopics and other supporting details. Standard Nonfiction conventions such as boldface or italicized type, sidebars and font changes will be noted. As a whole group exercise, the main topic and one or two subtopics will be covered. Students will select a form of energy to study. Students will then move on to completing the note-taking assignment independently on computers.

Fifth Grade students will have an additional challenge. These students will practice taking notes from video on heat transfer from Khan Academy, https://www.khanacademy.org/partner-content/mit-k12/mit-k12-physics/v/heat-transfer. Unlike traditional lectures, video lessons often provide closed captioning, replay and pause options, which students need to learn to use. These lessons are preparation for their research projects.

Fossil Fuels| Activity: Developing research questions

AASL 1.1.3 Develop and refine a range of questions to frame the search for new understanding.
4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

4th Grade Concept: Sedimentary rocks, Fossils

Science Content: Fossil Fuels

While fourth grade studies rocks, minerals and the formation of fossils, I will introduce fossil fuels, tying the formation of fossil fuels to their unit on Energy. Fossil fuels were formed in layers of sedimentary rock laid down over 400 million years ago. Differences in organic materials are what created the different fuels. In ancient rivers and oceans, decomposing plants and plankton were covered over with layers of silt[10], preventing

exposure to oxygen. [11] As the organic matter was compressed and heated, it decomposed into oil and natural gases. Eventually these percolated up until trapped by a layer of nonporous rock. It is through that layer of caprocks that we drill for gas and oil. Coal was formed 300-400 million years ago by the decomposition of more complex organisms, trees, ferns and other woody plants in swamps or estuaries were laid down in the same manner described above. Because carbon was sequestered when they were buried and the sulfur content of the waters in which they decomposed, pollution of the air and water occur when carbon and sulfur are released as these fuels are burned.

Teaching Strategy: Developing questions using QFT

Asking the right question is important. When you ask questions you become an active learner. Asking questions increases relevance for students as they become more involved with the topic. Questioning increases social learning time, necessary to understanding divergent opinions. Most importantly, by developing conceptual questions to answer, students acquire a deeper understanding of the subject. Sometimes in performing basic research, students opt to research a topic for which they know there is one correct answer, something safe and an easy "A". These are considered detail or fact questions. Participating in creating conceptual questions avoids the safe and easy answer. There are several methods of teaching question formulation. I will be working with two of them.

Question Formulation Technique (QFT) uses a visual image, aural stimulus or written statement as a focus. For this lesson, a short video clip from either *Earth: The Owner's Manual* or *Carbon Nation* on fossil fuels coupled with a brief demonstration of hydraulic fracking will be the focus for Grade 4. The instructions for building the fracking model is located in Appendix 2, although there are several online videos, such as Marathon Oil's "Animation of Hydraulic Fracking" (http://youtu.be/VY34PQUiwOQ) or Trial Exhibit's silent video (http://youtu.be/fFUxq9UolN4) that could be substituted. Students then brainstorm questions about that "hook" or "anticipatory set." During the third step, students analyze their questions, dividing them into closed and open ended questions. Students revise the close-ended questions into open ended ones. Next, students prioritize their questions to select the three that most closely match their task, whether it will be experiment design or essay. Students then must decide on the next step of their research, but before the actual research begins, the final step is to discuss or review what they learned as part of the process. While this would clearly work over a period of days rather than in a once-a-week class, the lesson is flexible.

AASL 1.1.1 Follow an inquiry-based process in seeking knowledge in curricular subjects, and make the real-world connection for using this process in own life.
4-ESS1.C: The History of Planet Earth Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.
4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

4th Grade Concepts: Sedimentary, Fossils

Science Content: Fossil fuels

There are three factors in our use of fossil fuels to generate electricity that concern me deeply: 1) fossil fuels as well as nuclear fuels are finite natural resources, 2) the availability of natural resources does affect economic and political stability, 3) climate change due to pollution caused by the overuse of fossil fuels. Our reserve of fossil fuels, coal, oil and gas was laid down millions of years ago, with no notable deposition since. The American Petroleum Institute admits that the fossil fuel we use to produce electricity is a finite source, possibly lasting only 60[12]to 90[13] years. Second, the scarcity of natural resources, such as the depletion of wood for fuel[14], has historically resulted in both economic and political instability. We need to recognize that not only will humans be facing shortages of "non-renewable" resources, we will be facing shortages of "renewable" resources if we do not reduce our consumption, simply because the rate of renewal is slower than the rate of consumption and that the lack of fuel sources may trigger economic and political unrest or even war. Finally, the overwhelming evidence that rising CO_2 emissions correlate with increased surface temperatures, setting into motion a host of ecological disturbances. These three factors should be enough to spur social change, but significant change is not yet happening. So, what can be done?

Given that energy use is unlikely to decrease, geologist Harvey Blatt proposes four choices: 1) increase mining and drilling for petroleum products, 2) increase use of the minor energy resources of nuclear power, hydropower and biomass, 3) increase our use of "trace" producers such as wind and solar power, and 4) develop new power resources.[15] Since, the rate of deposition is so slow and the rate of petroleum use so high, it becomes clear that choice 1 is untenable. Nuclear power, unpopular because of potential radiation leaks, should at least be considered in the future as a possible source of reliable electricity, especially now, since new developments for using "spent" fuel rods are being considered.[16] Hydroelectric power is limited in that many of the rivers that can be dammed have already been, so that few additional plants can be added at this time. Geothermal power and wind power also face some geographic constraints. What is clear is that we need to have multiple methods of generating electricity, to ensure that we maximize our use of the resources we have. That requires us to begin thinking differently

about our energy use and to develop new ways of generating electricity. And since the U.S. is not only not only the largest consumer of petroleum in the world, but also the second largest producer of coal and the third largest producer of oil, where the U.S. leads, many world nations will follow.

Teaching Strategy: Practicing The Big6

Big6 has six steps: 1) Identify task and information needs, 2) Brainstorm all possible sources of information and select the best ones for the task, 3) Locate the information sources and using Reader Tools, access the information within each source, 4) Engage the 5 senses and extract the information, 5) Synthesize and organize the information, 6) Evaluate the product and the process. By breaking the research process into these smaller steps, students focus on only one aspect of the task at a time, producing better results. In this lesson we move on to Steps 2-6 of The Big6 research method. After students determine their task and design a research question related to the formation and use of fossil fuels, then students will brainstorm all possible sources of information. They will select the best three sources for further research on the topic of fossil fuels or alternative energy and will design a research strategy and conduct their research using more than 3 sources. Using that information, they will create an Investigation[17], a format developed for classroom instruction by Tony Snead and Linda Hoyt that uses both short paragraphs and graphics on a single sheet, similar to the approach used by infographics or the popular Dorling-Kindersley "Eyewitness" books. Investigations are brief one sheet research reports on a student-selected topic that allow the student to clarify, summarize or analyze the topic. Telescopic text is clustered around a central graphic, with major concepts in larger type font and supporting details in smaller font. Like a word-cloud, the larger the font, the more important the idea. Illustrations must be captioned and the writing must be concise in order to fit on a single page. While nonfiction conventions are followed, since the page organically arranged, readers can begin reading anywhere on the page. Investigations will be presented it as part of a gallery exhibit or gallery walk. The last stage of Big6 requires students to evaluate both the process and the project.

Circuits| Activity: Using the Scientific Method to construct explanations and draw conclusions

AASL 1.1.1 Follow an inquiry-based process in seeking knowledge in curricular subjects, and make the real-world connection for using this process in own life.
4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4th Grade Concepts: Energy, light, sound, heat, electrical, motion, circuit, thermal, energy, transfer, light

Science Content: Circuits

Electricity has fascinated humans for centuries, but only after Thomas Edison refined the light bulb and large scale transmission of electrical power came into being did its use become common. All matter is composed of atoms, which in turn are made of protons, neutrons and electrons. The neutral neutrons and positively charged protons make up the nucleus of the atom, while the negatively electrons move outside the nucleus. Ideally, the overall charge of each atom is balanced by the positive charge of the protons and the negative charge of the electrons. However, electrons are only loosely held and can be jostled off the atom by heat or movement. The loose electron will then be attracted to the nearest positive charge, which may or may not be the atom from which it was bumped. Electricity is generated when the loose electron is diverted through a conductive material, through which it can move freely, to join a positively charged atom. It is the movement of electrons that generates electricity. A circuit is created when the electron is routed along a conductor, where the energy of its movement is used to do work.

Teaching Strategy: Scientific method

Electrical energy is generated, converted from another form of energy such as Chemical energy, Light or Movement and that will be the challenge of the science experiment below. Up to this point, fourth grade students have been building background knowledge. The Scientific Method requires students to make inferences based on both applied knowledge and observations. The Scientific Method, like The Big6 has six steps: 1) Posing a question, 2) Building Students will use their background knowledge through research, 3) Constructing a hypothesis, 4) Testing the hypothesis by using one variable, 5) Analyzing the data to draw a conclusion and 6) Communicating the results. In this exercise, students pose a question they can test. Students will be asked to explain circuits, design an experiment to demonstrate their understanding about the conversion of energy, diagram their circuit, and then use the components provided to test whether the design will work, such as wire, batteries, light bulbs, connectors, a buzzer, windmill, solar cell or a hand-cranked generator, to demonstrate their understanding. Students will record their observations and draw a conclusion.

Radiant Energy| Activity: Developing research questions about surface heating

AASL .2.5 Demonstrate adaptability by changing the inquiry focus, questions, resources, or strategies when necessary to achieve success.
5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

5th Grade Concepts: Patterns, Stability and Change, Systems and system models, Energy and Matter, precipitation, evaporation, condensation, jet stream, Gulf stream, temperature, air pressure, thermometer, barometer, anemometer

Science Content: Radiant Energy

The sun powers everything on our planet, directly or indirectly. Light energy, as we humans experience it, is only a small range of frequencies within the electromagnetic radiation emitted by the sun, which include anything from radio waves to x-rays, to gamma rays, the classification of which is determined by its interaction with matter.[18] Light, when it strikes an object can be absorbed, transmitted or reflected. Broad white surfaces, such as the shrinking glaciers reflect light[19], but usually when light strikes the surface of the Earth, it is usually converted into heat. This heat warms the oceans and cause currents, heats the air and causes high and low pressure systems and powers the hydrologic cycle.

Strategy: Developing questions using SCAN

We will begin this lesson with a whole group exploration of The Global Ice Viewer", http://cleanet.org/resources/43015.html, on the interactive whiteboard. The link will also be posted to Gaggle so students have access to it during the term. As their understanding of the background material deepens and students move onto more complex issues such as global climate change and nonrenewable resources, The Association for Supervision and Curriculum Development (ASCD) CompassQuest's four strategies: SCAN, FIND, ASSESS and PLAN can be employed. Each strategy employs steps represented by the acronym. This method divides queries into four types: Complex situations, Problems, Decision-making, and Implementation. Students would determine the type of situation, and select an appropriate model. For instance, SCAN stands for the process to understand a complex issue, and would be the most appropriate for understanding controversial subjects such as shale oil drilling. There are 4 steps: See the issues, Clarify the issues, Assess priorities and Name the next steps. Grade 5 will use this process to investigate solar, wind and water power during their weather unit. This lesson will begin by using headline news to help illustrate the problems with using fossil fuels and an informal assessment on the level of background knowledge. Students will discuss what they remember from their 4th grade research last year about energy. These will be clarified on the interactive white board using a graphic organizer. I will use small motor models and a small generator to demonstrate the conversion of energy. The Investigations assignment will be then be presented. Students will develop a single question for the purposes of research on wind, solar, geothermal or hydro power. Handy acronyms like these help students quickly adopt a process, but would require consistent use over a period of time. This method best suited for true collaborative teaching in both homeroom and LMC. After the question has been determined, students will return to the Big6 process to determine the best resources to answer their question.

Activity| Scientific Method & Collecting data

AASL 2.1.1 Continue an inquiry-based research process by applying critical-thinking skills (analysis, synthesis, evaluation, organization) to information and knowledge in order to construct new understandings, draw conclusions, and create new knowledge
5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5th Grade Concepts: conduction, convection, radiation, electromagnetic waves, thermal energy, convection cell, transfer

Science Content: Radiant energy, continued

Radiant energy is a kinetic form that manifests as visible light. What we humans can see is a very small range of the electromagnetic spectrum, the wavelength frequencies from about $4x10^{14}$ to $8x10^{14}$ hertz. It is the differences in these wavelengths that define color. It is wavelength that defines other rays such as gamma, radio and x-rays. As visible light passes through matter it is absorbed, scattered or reflected[20] and it is the interactions of light with matter that is the focus of this activity. Light is one of the conundrums that scientists simply accept, light behaves like a wave when traveling, yet behaves like a particle as it collides with matter.[21] When a light photon strikes matter, it is usually absorbed, releasing heat energy. It may be scattered as it passes through matter and it may be reflected back. While Grade 4 explores the reflected, refracted and scattered properties of light, Grade 5 will be studying the absorption of light and its conversion into thermal energy. After students have presented their results, they will watch a Carbon Nation clip showing green and white roofs.

Strategy: Practicing the Scientific Method

The Scientific Method will be reviewed as part of this lesson. While this method is rarely covered elementary library lessons, this is an important connection to classroom lessons, emphasizing that research methods allow us to approach problem-solving by creatively applying learned knowledge. The Scientific Method also has six steps: Posing a question, Building background knowledge through research, Constructing a hypothesis or "If…Then…" statement, Testing the hypothesis by using one variable and one control, Analyzing the data to draw a conclusion and Communicating the results.

The experiments themselves will be fairly simple, following student-led inquiry method. Fourth grade students will discuss whether light can be bent. In small groups the will form a hypothesis for proving their "If" statement. Students will be provided with mirrors, flashlights, water, clear plastic cups and asked to design an experiment that will

either prove or disprove their hypothesis about whether light can be bent. They will be asked to take pictures using their iPads, then, using Keynote, arrange their findings as a slide show presentation.

After a review of albedo, which I covered in their weather unit, fifth grade will design an experiment testing the heat absorbency of different materials. They will be asked to brainstorm a hypothesis. Students will be offered a choice of three sets of supplies: 1) Water bottles, white sand, dark soil, white paint, brushes, thermometers and water, 2) Black and white fabric and thermometers, and 3) Glass jars, rubber bands, black and white balloons and thermometers. They will be asked to work in teams to design an experiment that would test their hypothesis about the ability of light energy to be converted to another form of energy, thermal energy. Since I have the students in the morning, they will be asked to collect data in their classrooms over a period of three days and return with the data. They will be asked to select a method of sharing their findings, oral presentation, poster or other print medium or electronic. They will not be allowed to present on social media, although they will be encouraged to post data on Gaggle or Edmodo.

Appendix 1: Implementing Local Teaching Standards

Grade 4

4.P.1 Explain how various forces affect the motion of an object

4.P.1.1 Explain how magnets interact with all things made of iron and with other magnets to produce motion without touching them.

4.P.1.2 Explain how electrically charged objects push or pull on other electrically charged objects and produce motion.

4.P.3 Recognize that energy takes various forms that may be grouped based on their interaction with matter.

4.P.3.1 Recognize the basic forms of energy (light, sound, heat, electrical, and magnetic) as the ability to cause motion or create change.

4.P.3.2 Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

4.E.2 Understand the use of fossils and changes in the surface of the earth as evidence of the history of Earth and its changing life forms.

4.SI.1 Apply criteria to determine appropriate information resources for specific topics and purposes.

4.SI.1.1 Use various types of resources to gather information (including print and online media).

4.SI.1.2Use relevant sources of information for an assigned task.

4.SI.1.3Use reliable sources of information.

4.IN.1 Apply appropriate strategies when reading for enjoyment and for information.

4.IN.1.1Implement appropriate reading strategies when reading for information.

4.TT.1 Use technology tools and skills to reinforce classroom concepts and activities.

4.TT.1.1 Use a variety of technology tools to gather data and information (e.g., Web-based resources, e-books, online communication tools, etc.).

4.TT.1.2 Use a variety of technology tools to organize data and information (e.g., word processor, graphic organizer, audio and visual recording, online collaboration tools, etc.).

4.TT.1.3Use technology tools to present data and information (multimedia, audio and visual recording, online collaboration tools, etc.).

4.SE.1 Understand issues related to the safe, ethical, and responsible use of information and technology resources

4.SE.1.2 Understand ethical behavior (copyright, not plagiarizing, netiquette) when using resources.

Grade 5

5.P.1 Understand force, motion and the relationship between them.
5.P.2 Understand the interactions of matter and energy and the changes that occur.
5.P.2.1 Explain how the sun's energy impacts the processes of the water cycle (including evaporation, transpiration, condensation, precipitation and runoff).

5.P.3 Explain how the properties of some materials change as a result of heating and cooling.
5.P.3.1 Explain the effects of the transfer of heat (either by direct contact or at a distance) that occurs between objects at different temperatures. (conduction, convection or radiation)
5.P.3.2 Explain how heating and cooling affect some materials and how this relates to their purpose and practical applications

5.E.1 Understand weather patterns and phenomena, making connections to the weather in a particular place and time.
5.E.1.3 Explain how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.

5.SI.1 Apply criteria to determine appropriate information resources for specific topics and purposes
5.SI.1.1 Use various types of resources to gather information (including print and online media).
5.SI.1.2 Use relevant sources of information for an assigned task.

5.IN.1 Analyze appropriate strategies when reading for enjoyment and for information
5.IN.1.1 Differentiate strategies when reading informational text in a variety of formats (e.g., print, online, audio, etc.) to complete assigned tasks.

5.TT.1 Use technology tools and skills to reinforce and extend classroom concepts and activities.
5.TT.1.1 Use a variety of technology tools to gather data and information (e.g., Web-based resources, e-books, online communication tools, etc.).

5.RP.1 Apply a research process as part of collaborative research.
5.RP.1.1 Implement a research process by collaborating effectively with other students.

5.SE.1 Understand issues related to the safe, ethical, and responsible use of information and technology resources.
5.SE.1.2 Understand ethical behavior (e.g., copyright, not plagiarizing, netiquette) when using resources.

Appendix 2: Fracking model

Materials:

Clear container such as a small pet carrier, plastic shoe box or salad greens box
Sand
Liquid food dye or sugarless packaged drink mix
Clay, natural or modeling
3/8" tubing (Bubble tea straw or floral support straw)
Pump taken from liquid soap or hand sanitizer dispenser
Aquarium gravel
Water
Syringe
Piece of nylon stocking

(The Awesome Aquifer kit is available through: http://www.groundwater.org/ and has almost of these items it.)

Procedure:

1. Drop food dye or packaged drink mix in bottom of container.

2. Cover with sand.

3. Cover sand with a layer of clay, sealing edges. Using the large tubing cut out a hole. Remove clay plug from tube and re-insert through clay and into the sand. Use more clay to seal the tube to prevent water leakage.

4. Add a layer of gravel.
5. Cover gravel with water to simulate groundwater. At this point students can see that the groundwater is not contaminated.

6. Using syringe, add water to the tubing to simulate the solvents used during fracking.
7. Cover end of pump with a piece of stocking to serve as a filter. Pump out mixture of dye and water that represents the shale oil. Dye will leach into the clean water if there are any leaks.

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