Energy Visualized and Easily Explained to 3rd Graders

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Objectives

As a Spanish Education major, my main focus for the past few years has been learning language and culture of Spanish speaking countries. For one year I taught general English in another country; then I taught art in a summer school before teaching middle school Spanish. When I entered Lewis elementary to teach 5th grade, which included science, my knowledge of science was limited to Biology 101 and high school chemistry and biology. Needless to say, the basic definitions were okay, but I felt highly incompetent to teach science, especially to touch on energy, in fear that my lack of knowledge would relay misinformation by accident to the students.

Due to my lack of science knowledge, I felt inspired to participate in a science Delaware Teacher Institute seminar, so that I could find the confidence, research, and words to not only teach, but inspire students to dig deeper in learning science. While the past few months I have heard and read perhaps overwhelming amounts of science for my liking, an assembly the other day where most students raised their hands about how they loved science reminded me how this is worth it. This seminar has had me think, go back to the drawing board, dig deeper, and gather information that I wish to impart on any teacher, from those who want to brush up on their science knowledge, review different information and activities a colleague has created, to someone like me- who doesn't consider themselves a "science person" but understand the value of finding a manageable way to teach it.

I work at William C. Lewis Dual Language Elementary School in Wilmington, Delaware. Last year I taught 5th grade; this year I teach 3rd grade. In 2015-2016, about 76% of my students are of Hispanic Heritage (10% of that percentage are students who don't speak Spanish at home), 11.6% Caucasian and 16.3% African American. The school is one where all students receive a free lunch and free breakfast; with the school lines being in Wilmington, the poverty rate is high (73.4%) (State of Delaware). Due to the dual language immersion program and rigor of the mathematics and reading curriculums, science is often a "Fun Friday" activity for sake of timing, or sometimes goes to the way side of importance, there is a misconstrued idea that science can be too complex to teach grade schoolers sufficiently for the amount of time we are given.

In addition to the challenges of high poverty, 8.8% of the school's population are enrolled in as students of special education, with 504s or IEPs (Individualized Educational Plans). 55.5% are categorized as English Language Learners (ELL) (State of

Delaware). Last year, as I taught Spanish, I didn't have to take into consideration ELLs but rather SLLs (Spanish Language Learners). This year, however, I am teaching English and know that every subject is critical to use Sheltered Instruction Observation Protocol (SIOP) models and illustrations to help my students learn the best way they can. I will not be "directly" teaching science as a subject that shows up on their report card, but like other teachers, we have science centered reading books and opportunities to teach about multiple disciplines in their reading classes.

While designing this curriculum, I have looked at both the science as well as the social studies curriculums, in order to integrate them into reading discussions and lessons. For the first unit of the Scotts Foresman book for reading class that my student uses, the focus deals with money and basic economic resources. So ideally, I will integrate learning about energy throughout the different stories. This would not only guarantee a buildup of understanding about energy, but also a stronger sense of how energy is in many forms and used in many different ways. A goal of mine is for students to clearly state what energy is, where it comes from, and how they see it in their everyday lives as children.

Another objective of mine is for students to gain an awareness that we must investigate, advocate and inform ourselves, as well as others, about how we impact energy and the environment. I believe it is important for students to see the impact we have had, see the concrete patterns and examples of the past and current day situations, as well as the hypotheses and direction our planet is going, as they are the generations who will be the future leaders who make energy policies and decisions that impact the world.

As the year is progressing, I am realizing how to better apply what I have learned in DTI about energy through English class that is an integration of reading and social studies curriculums. For 3rd grade science, the main unit is Earth Materials for Science- it introduces the different types of rocks and minerals. While energy from oil, gas, coal and renewable resources is a totally different topic, this built science curriculum supplements a deeper learning of economics found in the social studies curriculum, as well as reading curriculum throughout the 3rd grade school year. I chose implementing energy in a 3rd grade curriculum too, because it identifies misconceptions students tend to start to have at their age due to their lack of knowledge of science. In this way, their basis of understanding of energy, why it's important and where it comes from is a strong base, which is reinforced throughout English and Social studies class that science is integrated rather than an extra addition that one tries to cram into the elementary schedule.

My main goal is for my students to become educationally informed students. I want my students to be confident about talking about energy. My students come to me only knowing that we should turn off the lights to the bathroom and close the Chromebooks when not using them, but I think holding a discussion of "why conserve energy" would help give them a why and reason behind our actions. A reading compliment to this is to

share the story of the starfish and how we can make a difference little by little[1]. This may seem out of the science realm, but when in reality this story can help humanize the sometimes only robotic, distant aspect of science being just facts and numbers. Science does affect people, and people can make a difference in science, therefore tying in the starfish story I would highlight how learning about energy is purposeful and meaningful for their lives.

Overall, my objective for my 3rd grade students to identify and explain in their own words what is energy and how it can be found in society. I want my students to be able to describe where coal, oil, natural gas, and electricity come from. In addition to identifying and explaining with basic terms with some science vocabulary what they are, I want them also to be able to know how energy is relevant to their lives and how they can help the transmission of energy at a local level, using the Green Team to help be a program example that extends outside the classroom and into the whole school. Below is a breakdown of the outline of the course, from the first objective to the last objective that has a culminating activity based on what the students learn from the previous two objectives.

Before teaching anything, they will take a misconception survey, found in Appendix B. The appendix lists 10 points that will be talked throughout the unit, along with the answers right after for quick reference, though more detail is within the background section of the unit. The misconception survey can serve as a basis of learning prior knowledge. It is a ½ page survey to gauge what the students think based on these statements. These statements come from misconceptions talked about during the DTI seminar, as well as misconceptions or lack of knowledge I had to learn about to confidently talk about energy based on research. Questions are based on background of resources of energy in first part of curriculum. One can revisit them after first part, and again at the very end for repetition and reinforcement of unit. While all these points are touched on through the regular curriculum, a brief explanation of debunking the misconceptions are below for a quick reference.

Background- The social studies tie in

Objective 1: What is energy and where does it come from?

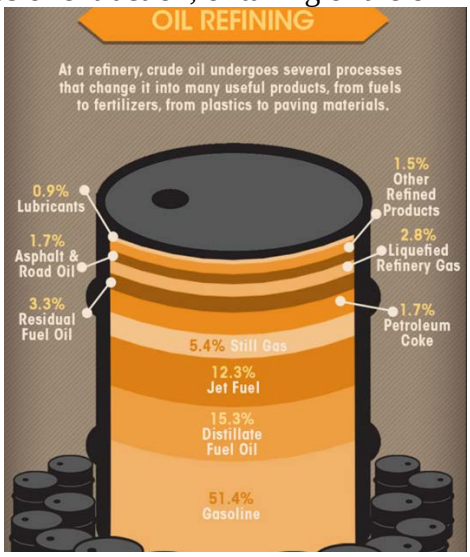
During the social studies unit, it had us touch base on the natural, capital and human resources in our world. This year, I had a successful introduction of this social studies topic by providing a column chart to put the definition and options. After talking about

[1] "Star Fish Story," Last modified, 1999. http://www.all-creatures.org/stories/starfish.html

the different types, and quizzing them using American Sign Language symbols of “N”, “S,” and “H” of whether they understood what a particular object was. This is to help visual and kinesthetic learners. I then had them pick anything in the classroom to give me to illustrate the concept of trading and bargaining. As an extension of this to branch into science, I would then focus on the natural resources and go into teaching about nonrenewable and renewable resources.

The nonrenewable resources that are in this world include coal, natural gas and oil. I think that one would think of teaching the nonrenewable resources first, as students easily understand that it can’t be easily replaced within a short period of time. An analogy could be food eaten at a dinner table. You have what’s on your plate, but once that’s gone and maybe the surplus on the table, the meal is done. If students talk about “Well, what if one goes to the store?” You could talk about how the store may not have anything anymore because so many people want it. This is my stepping stone to delve into talking about energy sources and how coal is made, as well as where we get oil and natural gas.

It was interesting to hear about how gasoline is made from oil. The movie “Deepwater Horizon”[2] provides an entertaining yet also description basics on how an oil rig works. It mentions how we have mentioned in class on how one drills in the ground to obtain oil, which then is refined to fuel our cars. Different products come from refining- or cleaning- the crude oil, or dirty oil, that comes from the ground. See figure[3] below. This resource is also great, to show the steps of extraction, or taking of the oil from the ground.



While researching, I also found a book that is elementary school age appropriate

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2 Participant Media, Peter Berg, *Deepwater Horizon*, 2016.
3 "From ground to car," Tradequip International, accessed Jan 2017, https://www.tradequip.com/articles/groundtocar

which best breaks down step by step the process for students to read and understand.[4] Students could read this during a center time or in groups, to then make posters to illustrate how we get our gasoline. It amazes me how such a process has been mass produced- from finding a spot with a promising amount of oil supply, to then use all the machinery just the right way to suck it up pipes. The oil then goes to a refinery, to be heated and separated into different parts, whereupon the gas is then shipped via car and pipelines for people to use for cars. The gasoline isn't just used for cars, but also to help heat homes and cook. Students are to be able to walk away understanding that crude oil is the initial oil taken from the ground, that is then separated into different products.

It is important for students to understand the basic fact that while we may first think of gasoline as energy, as it makes cars go, before going further about fossil fuels, it would be critical to mention that all energy comes from the sun.[5] Energy does not disappear or get destroyed; it is transferred and in different forms, such as heat, energy in plants to animals, to how energy runs objects around us. From seminar, there were intriguing videos that helped students see pictures of the sun, as well as understand how it is the source of all energy. The fact that it takes about 8 minutes for the sun to contact earth can marvel kids, and spin off to a creative writing piece in writing class to supplement this important finding. Students could write what they would do if they only had 8 minutes before the sun were to go out, if that were the case. Tying facts about energy via the sun through a creative thinking exercise will get students to think outside the box, in addition to reflect on basic facts that they will have learned about the sun. This can be done after showing the Magic School Bus's episode on energy, which not only talks about the sun but also covers renewable energy sources. By having students realize that the sun allows us to breathe, not just provide us sunshine during the day. [6] After explaining the nonrenewable resources, you could spearhead a discussion to start with "Well, what else could we use?"

Renewable energy is energy that doesn't go away once it is used. The main renewable energies that come to mind are solar power and wind power. Renewable energy is energy that doesn't go away once it is used. The main renewable energies that come to mind are solar power and wind power. The solar power students could have visually already seen on top of a house, or in a field by a road. While the sun provides heat and light, we can harness the sun to create electricity. The blue rectangular pieces one sees are made up of Solar Photovoltaics or PV.[7] The solar cells that make these panels has different layers of

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[4] Shannon Knudsen, *From Oil to Gas*, (Lerner Publications Co, 1971), 6-22.
[5] "Energy 101: Solar Power," (Energynownews). accessed Dec 2, 2016, https://www.youtube.com/watch?v=NDZzAIcCQLQ
[6] "Magic School Bus: Getting energized," accessed Dec, 10, 2016. https://www.youtube.com/watch?v=12ZgGY99Q20&t=2s.
[7] "Energy 101: Solar Power," U.S. Dept. of Energy, 2011, last modified Feb 8, 2011, accessed Dec 8, 2016, https://www.youtube.com/watch?v=0elhIcPVtKE.

silicons for currents to pass. It may be a bit to wordy to talk about photons and electrons, but as photons strike the cell, electrons can take off and are collected into a circuit to create electric. To give students an idea of size, one PV cell is 1/2 inches by 4 inches and 12 PV cells are taken to charge a cellphone.[8] As a class, you can show the size of one PV and 12 PV, for students to understand why the solar panels we see outside are so large in order to power a lot more than a cellphone. Most homes only convert solar into electricity around 15-20%, which doesn't sound like much, but a little can go a long way.

One would have to point out that while we have the sun, if there is a storm or cloudy days, the solar energy harnessed may be all used until the next time the sun is out. Therefore, it can be an inconsistent energy source and not the best choice if one were to live in rainy areas. This can branch into talking about social studies geography of longitude and latitude, of how it is colder farther away from the equator and where there are cloudier days than if one lived in say Puerto Rico.

Wind is another renewable energy that can be visualized for the students. Windmills are the old fashioned ones one sees; the modern ones are actually called wind turbines.[9] They harness the winds' energy. The blades that are uneven, to capture the pressure of the wind. The blades are attached in the middle part called a shaft. Inside the shaft is a generator that turn in many circles, or revolutions per minute (RPM), to then harness it to be used for electricity.[10] The wind turbines need a lot of wind, and during the DTI discussions, it was intriguing to find out that many wind turbines are 300 feet + in the air or found on high hills or mountains. Factors to consider for implementing a wind turbine is land regulations of country, as it is a sight sore, as well as how much wind realistically can be captured to make it worthwhile to put one in an area.

The light bulb and it's invention based on the electricity current is has an interesting back story that students would likely remember, as well as then understand basic terminology of what AC/DC batteries are. I learned that DC batteries, or "direct current" batteries, only goes one way, thus the title direct.[11] Students may know that Thomas Edison invented the light bulb, to associate batteries with currents, not just light bulbs, but what is interesting is the background story of Edison's work. He invented the DC light bulb, but being a one way current, so it was not as efficient. His rival in the 1880s, Tesla invented AC, or "alternating currents," which goes in two directions.[12] The energy

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8 Richard Komp "How do solar panels work?"
9 "Energy 101: Wind Turbines," U.S. Dept. of Energy, last modified Feb. 8, 2011, Accessed Dec 8, 2016. https://www.youtube.com/watch?v=tsZITSeQFR0
10 "Energy 101: Wind Turbines"
11 Chris Mahl "AC vs. DC," accessed Jan 10, 2017. https://www.youtube.com/watch?v=BcIDRet787k.
12 Tia Ghose, "Nikola Tesla vs. Thomas Edison: Who was the Better inventor?" last modified Jul 2014, http://www.livescience.com/46739-tesla-vs-edison-comparison.html.

flow is back and forth, making it quicker and more efficient than DC. While Edison is the main inventor that is remembered in history and the first for the light bulb, it was Tesla's AC that began to be more widely used. A dark fact was that Edison tried to dissuade of people using his competitor's alternating current electricity by electrocuting an elephant.[13]

In Woodford's book, it makes a point on how the sun could be related to a battery.[14] It can be used as energy when it is around, but when it is not there, not so much. The book provides a basic understanding on how energy comes in different forms, from being invisible too hard to harness, as well as the multiple uses of energy. After students understand that the sun is the source of all energy, one can spiral back to mention fossil fuels. I found several times throughout the seminar where my own misconceptions were corrected- I had the incorrect notion that fossil fuels- natural gas, oil, and coal, will all be used up within the next 30 to 50 years and then we'd be in trouble. The seminar made me realize there is still plenty of oil left- China has a lot still yet to be tapped. Another research book not only reaffirms the short time span is a myth, but also brings up the question of how burning it has been linked to increased carbon dioxide and climate change.[15] Air pollution and oil spills can also affect where people live and the environment. An intriguing fact in which students can visually touch and gather is the fact that all sorts of plastic are derived from oil in some way (18).[16]

The revelation of how plastic has some factor of oil helps bring the matter of heat into discussion. Basic terms, students know that heat keeps things warm. This brings back how the natural first source of heat is from the sun, which students can relate to the seasons for them to grasp the concept of energy in this way. Steve Parker's book is an excellent source about heat as a form of energy. It breaks down its pages, talking about energy's relation to temperature.[17] It also mentions how heat travels. When something heats up, the heat rises and steam is sometimes given off, to then go out in the air. CO2 levels are higher than ever, and a direct effect of climate and global warming around the world. The rising of CO2 (Carbon dioxide) levels is called the Keeling Curve, and is widely evident within the last 50 years of energy usage throughout the world.[18] As steam condenses, sometimes clouds form and then rain falls; rain can be then used for tidal or for power if it goes into a damn. It breaks down the vocabulary word of convection and

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13 "Thomas Edison" The History Channel, accessed Nov 25 2016. http://www.history.com/shows/america-the- story-of- us/videos/thomas-edison.

14 Chris Woodford, *See for yourself: Energy,* (New York: DK Publishing, 2007), 8-12.

15 Lauri Friedman, *Fossil Fuels,* (Reference Point Press, 2010), 10.

16 Friedman, *Fossil Fuels*, 18.

17 Steve Parker, *Science View: Heat & Energy,* (Philadelphia : Chelsea House Publishers, 2005.), 14, 20.

18 Helen Briggs, *The Keeling Curve legacy,* (BBC News, 2007), accessed Dec 15, 2016.

conduction in simple terms to help students understand how heat travels. Convection is like how heat rises for a hot air balloon, whereas in conduction, two objects make contact and heat flows. They even talk about infrared radiation, which students can connect to how some get sunburns in the summer after a long time in the sun rays. It is not to be forgotten that heat is a key step in the process of getting gasoline from oil and how oil was made from fossils after thousands upon thousands of years of buildup and heat. In the DTI sessions, it was made clear that it takes thousands of years for it to be made; it is not something that scientists have been able to create more of. This strengthens the concept that it is a nonrenewable energy.

The Background- The Reading Curriculum Tie in

Objective 2: How is energy used throughout history?

Scotts Foresman is the Red Clay district Elementary school curriculum for the subject of reading. As the first story's question for the week is "Why money is important and how it affect our lives" it can also be a springboard to talk about why energy is important and what is energy anyway. The basics need to be talked about before a deeper level of understanding is to occur, so it is a relief to see how I can integrate science into other subjects. It is important to see how the usage of energy has changed throughout history, to see the differences of then and now. It also provides energy with a storyline and something to physically attach the resources to, as it is proven that stories are helpful in understanding concepts. I believe that it is a crucial connection to humanize science- to make it hit home and be more part of their life, whereas sometimes science seems to be only numbers, scientists, and statistics. Seeing old pictures of the grueling work of digging for coal, talking about the negative side effects of peoples health and dangerous conditions of living, is part of American culture and something that should not be forgotten.

The particular stories in the reading curriculum are the following, with a deeper discussion of the points touched on explained in later sections of this unit paper. "Boom Town" is the first story in Scotts Foresman. It talks about how people moved out west for better and also dig for gold. A connection of how people looked for oil can be used, to touch on oil in this section. In unit to, there is the story "William's House," that talks about how in the 1600s, people had to use basic tools to create log cabins and there was no electricity in the houses. People used candle lights and sometimes burned oil, until the invention of the lightbulb in the 1800s. Unit 3 there is "The Gardener," which talks about the Great Depression.[19] While this story is mostly social studies, one can make the connection that people couldn't afford not only their rent, but also couldn't afford their running water, heat or electricity. In other words, they could not afford the *energy* they

[19] Sonia Levitin, Ginger Howard and Sarah Stewart. *Boom Town, William's House and The Gardener,* (Scotts Foresman, 2008),16, 254, 284.

needed to run a normal household.

A year ago, when I taught some science in 5th grade, I felt very comfortable when I noticed that energy was to be touched on in the year, as I did not have a solid foundation or understanding of energy. After the DTI sessions and readings as well as my own investigations, I can explain energy helps set many things in everyday life in motion. I will do this by asking students to point to something that they think doesn't have any energy and I will say how we may not see the energy because it is stored. Energy is in many forms and is often helpful to be thought to as a way to get something to happen, such as a car to start or the light or one's phone to turn on. Energy that we don't see in physical motion often times is potential energy; when something moves, that is kinetic energy and easier for students to see and accept that energy is there. Energy is all around us and as a whole encompasses fossil fuels, renewable resources, and electricity, to name a few.

The reading curriculum has many historical points that can be used to then direct conversations about the history of energy. Chapter 4 Energy in Modern World breaks down how different fossil fuels came into use, to then electricity. It breaks down into sections, noting how coal was first widely used, before oil came into play. Students can connect to social studies of how trains used to be run with coal. Coal is made from a combination of sedimentary rocks and organic plant matter (including insects) broken down by high pressure heat over millions of years.[20] Coal was a major use through the 1800s, but found to be insufficient and limited in power capacity. Oil was not a wide source of powering machines until the 1900s, and principally, not until after World War II.

An important lesson to point out to students is the difference of the component make up between oil/gas versus coal. Youtube has a good introduction about this, that does a compare and contrast of the three elements. Oil and gas come from under the water's surface and microorganisms built up over time. Coal is made up from buildup of vegetation in warm and wet environments.[21] Students can do a compare and contrast sheet explaining where the sources come from.

It was also intriguing to learn during the fall DTI sessions that nuclear energy is not bad. One article given during the session mentions the worst nuclear power plant disaster of Chernobyl in Ukraine in 1986, and then a coolant and fuel meltdown in Japan in 2011 after an earthquake and tsunami hit that region further discredited nuclear power.[22]

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[20] Vaclav Smil, *Energy in everyday life: Ch 4 Energy in the Modern World Chapter 4*, (Oneworld Publications, 2006). 105, 110.

[21] "Coal, Oil and Natural Gas" (Geoscience), accessed Dec 15, 2016, https://www.youtube.com/watch?v=sQncFcuYWos&feature=youtu.be

[22] F Richard Martin, *Fail-Safe Nuclear Power*, August 2, 2016

Accidents can happen with many things, but overall, nuclear power is safe and a lot more efficient than using nonrenewable energy. It takes so little nuclear energy to generate a lot of electricity. Overall, nuclear plants have had not so many fatality issues than many other power plants; in fact, is a safe means of producing electricity. China is the leading group that is building nuclear power plants, even though they were first made in the United States.[23]

Objective 3: How does energy affect my everyday life?

What I found interesting is that one can find ones' estimated carbon print online. I would explain to my students that there are ways to show how much energy is used on certain calculations. A startling finding for me was that even though I am conservative in using energy at home, my travelling and commuting to work puts quite the dent on the environment, will all the gasoline consumed between flights and car rides. The consumption with those trips don't disappear; while I do conserve and am good at helping the environment with some activities to lessen unnecessary usage, it doesn't give me a discount or a deduction of the amount of energy I help emit into the air, that in turn affects the climate, air, etc. The International Footprint Challenge* shows me the world average in comparison to my carbon footprint. If I just put into consideration the long flight to and from South Africa that added 10,000kgs![24] This would be a good group activity, which constantly shows the world average, to then see the slow or quick build-up of carbon footprint in a class discussing what an average American consumes.

While discussing how energy affects our everyday lives, a simple kid energy survey can be filled out at home, individually, or one can encourage the parents to fill it out with them. See Appendix C for the basic questions, where students can see where energy is being used and the amount of energy they use. This will get the students to become aware of the many different ways they use energy without realizing it. A branch from this would be for students to revisit this survey after a month, and see if they consciously decided to cut back on their brushing of their teeth or minutes in the shower. This also promotes the skill of being a good citizen, as it is teaching the students to be mindful of their surroundings and how they manage energy. A class discussion would be good to talk about how conserving, or refraining, from using lights or water is a good idea. The discussion would wrap up by creating a shift; instead of not thinking about our usage, being mindful and thinking of how much they really need to use, and perhaps change their ways. It can create ripple effects of students to become upstanding citizens. Points in the discussion on how wearing layered clothing can keep them warm and not use as much heat, which in turn makes their heat bill lower. The same method applies for keeping

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[23] Richard Martin, *Fail-Safe Nuclear Power*, 1.

[24] "International Footprint Challenge," accessed December 2, 2016. http://web.stanford.edu/group/inquiry2insight/cgi-bin/i2sea- r2a/i2s.php?page=compare.

things plugged in and lights on.

This last objective builds up for a large student project at the end of the semester. Students will research about a certain alternative energy resource- solar, wind, and water- to then decide which is best. Students will compare and contrast their favorable renewable energy resource between a nonrenewable energy resource, such as gasoline or oil. They will try to sell their product, based on facts that they have gathered through library books, online media or online class notes. Students can compare and contrast, filling out the pros and cons of each resource. See Appendix G for an example. Their research can be for their own organizational notes to articulate about the resources, as well as a way for them to write compare and contrast paragraphs of the resource of their choice.

Strategies

I will use round robin activities to go over topics, such as everyone brainstorming of what types of renewable energy sources are for one time around, followed by nonrenewable and examples of items where we use electric or fossil fuel energy. Sentence stems and visual aids will be projected on the Smartboard, a tool I use daily to project items for the students. I have found that with younger students, especially those who are English Language Learners, visuals are critical in the deeper understanding and the connection of their prior knowledge, to the information at hand.

Before teaching it, I will have my students fill out a survey that is compiled of many misconceptions about energy relating to earth material and everyday use. Most of the misconceptions will be based on discussions from the DTI Seminars, as well as articles read for class such as Engineering and Science and Energy. The misconceptions are listed in the attached appendix, with the truths explained for the misconceptions throughout the background section but briefly restated on the answer key section. The survey will be taken in the beginning of the class; a teacher can choose to revisit this misconceptions as the unit goes by, for students to explain the actual truth to debunk the misconception. This can be an informal assessment to see students' understanding and articulation if they come into a real life situation to clarify misconceptions on energy topics. For example, in the spring I learned that there isn't a lack of supply of oil in the world. Media often shows that there is a 30 year supply less of lots of natural resources when in fact there is plenty, especially in China for hundreds of years more. Students will practice in a form of a debate, stating they heard the other person, to then kindly say that they have learned otherwise in Science class. This will help promote kind correction of misconception based on facts learned rather than forget to mention the sources to prove the actual truth.

The unit will be spread out over the first unit of Scotts Foresman "Dollars and Sense," and even go into the second unit, based about smart solutions. The culminating activity of a PSA to talk about the resources to put around the school ties in talking about finding

more than one solution for a situation. Students will work individually with exit tickets, while reading too in groups. I will find different levels of reading to differentiate for my learners, of passages talking about different resources and how to use energy more wisely. I find that talking about energy can be dense, with so many terms, that I want to make sure that they learn at where they are, rather than become frustrated and overwhelmed.

There are several ways in which you can reinforce the awareness of electricity usage in the classroom. If you have a classroom that has a bathroom, teachers could tell students to owe a reward point in their school if they leave the light on in the bathroom. Another penalty would be if the light was not turned off when leaving the classroom; this could be a class job and if the student forgets to turn off the light before going to specials, they owe a point or whatever your school system uses. To reinforce positive behavior, points can be given to students who remember turning off the light.

Another strategy include creative writing assignments. One mentioned earlier was having students make a creative writing piece based on the truth that it takes about 8 minutes for the sun to come to Earth: What would you do in 8 minutes of sunlight if the sun was blocked or burnt out? One could have the students write for 8 minutes or be in the dark for 8 minutes, for them to reflect how the sun and light is really needed.

Another writing assignment would be based on learning about solar and wind energy: After explaining what incentives are (like gifts given to the customer to buy their product) and rebates (the customer getting money back by buying the product, so it's like a discount but one receives the money after paying the price given. The customer most times need to send in a receipt to make sure they get part of their money back after they buy it). Students are to create a 30-second elevator speech of why one should buy their form of renewable energy, including why it is a good alternative and two incentives or rebates for their potential customers.

An end of unit writing assignment can be to look back on students pre-survey answers about energy usage: Now that we have learned a good deal amount energy in different ways and its usage, would you change your lifestyle? Why or why not. Give specific examples, basing your argument off of your survey at the beginning of the year and at the end.

A post-test is attached, which can be used as a summative or formative assessment, to see if students grasped the material. See Appendix D. This includes a short explanation free response, to see if students can concisely articulate the flow from crude oil from the

ground, to how we get gasoline into our cars. It is also for students to explain the difference between nonrenewable and renewable energy in their own words. While there is a question that relates to energy and humans, in relation to our food is not touched on in depth in this unit, it seemed an important piece to put on here for them to reflect that it is in and around their lives all the time and is important to understand.

Classroom Activities

In Class Activities

There are many hands on activities and programs I have discovered that students can do in order to enhance their knowledge about energy. In particular, I have found it fascinating the different types of activities one can apply in science- it is similar to the other subjects, in that there are fairly simple class activities, as well as online self-guiding activities in the resource section. Furthermore, I have found through talking to colleagues several different possible places locally in the Delaware area where students can go and make a personal connection with energy.

In the classroom, there are many group activities in which students can participate in order to see how energy works in their everyday lives. A social studies activity would be for students to sort out the different sorts of resources we have, through separating physical items or a list of items on the floor. A fun introductory lesson would be for students to find human, natural and capital resources around the room to then bring to the rug to round robin share. What I have found useful is to then dig deeper into talking about natural resources through this link of social studies- otherwise it is hard to interlink energy into the already compact reading curriculum.

Sentence starters are key in order for classroom discussions to take place. For discussions to talk through misconceptions, or the processes of oil to gasoline, or energy to ourselves, see Appendix E.

In School Leadership Opportunities Involving Energy Awareness

As our school is trying to be more environmentally friendly, we are resurrecting the Green Team within our building. This entails students helping collect recycling for it to be put in a recycling bin instead ultimately the trash. This is when education and PSA announcements play in, where they can apply what they have learned from our discussions on nonrenewable and renewable sources and how we use energy to put onto posters around school.

An additional follow up activity would be to look at how leaves and natural resources decompose. The basic learning of compost will help reinforce the Green Team at our school, as well as give an opportunity to give the basic fundamentals of how oil is made

with pressure and heat. Visuals and prior knowledge is key to help students understand, especially finding creative ways for city students to be able to find familiar concepts or objects to help better grasp a concept.

Field Trips

The Hagley Museum

Science is all around us, especially in Delaware. It was not until I went to Hagley recently when I realized how there are so many resources around in Delaware where programs are already set up to teach students. The property was where the E.I. DuPont family lived, as well as ran their gunpowder business in the 19th century. The Hagley Museum's program has students learning about how they made gun powder using machines to make energy and create more items. It also touches on the industrial revolution and how much energy a kid had to use to help their families survive. There are grants available so that the cost of the trip is free, including the cost of the buses sometimes. It is located in Wilmington, near the Tatnall School.

The Recycling Center

The Department of Solid Waste provides free tours where students see how materials are sorted, broken down, and recycled. Students get to see how items are recycled. This can help illustrate that things don't just disappear, just as energy doesn't disappear or get destroyed; it goes to another place and may come out in different forms.

The Iron Hill Museum

This is a great museum that provides workshops for class trips for both minerals as well as energy usage through recycling. This museum is located in Newark and has a low cost fee of $3.50. What fascinated me while researching is that they also have a social studies component on Leni Lenape Native Americans. This also correlates to the reading curriculum, with the story of "Pushing Up the Sky." This brought me to thinking that teachers could extend the energy conversation so as to compare and contrast the energy Native Americans used versus how much energy we exert for everyday life nowadays. The Iron Hill Museum has many workshops that can range from Pre-K to mostly 5th grade, but has one like "Whose trash is it Anyway?" which takes classes up to 8th grade.

Resources

In addition to the Smartboard, the district has made a point to make technology a 1:1 resource starting in 3rd grade. This means that each of my students has a Chromebook, where they have access to the internet and google documents to easily research, store and share their work with me. I have found several websites where students can go on during

center time for a science center, to become more familiar with energy and resources in a kid interactive cartoon image way, in addition to real photos and kid analogies. Some of these websites include:

"Adventures in energy," last accessed December 10, 2016 http://www.adventuresinenergy.org/interactive/main.swf.

"Matters and energy," last accessed December 2, 2016, http://archive.fossweb.com/modules3-6/MatterandEnergy/activities/resourceid.html.

"Using Electricity," last accessed November 20, 2016, http://www.bbc.co.uk/schools/scienceclips/ages/6_7/electricity_fs.shtml.

"Electricity and Energy," last accessed January 4th, 2016, http://interactivesites.weebly.com/electricity-and-energy.html.

"International Footprint Challenge," December 2, 2016. http://web.stanford.edu/group/inquiry2insight/cgi-bin/i2sea-r2a/i2s.php?page=compare.

While the main source of research for students will be the internet, here are some book resources for students:

Robert Gardner. *Sizzling Science with Heat and Energy.* (Enslow Publishers, 2006).

Shannon, Knudsen. *From Gas to Oil.* (Lerner Publications Co, 1971).

Other resources for teachers include:

Chris Woodford, *See for yourself: Energy,* (New York: DK Publishing, 2007).

Denis Walker, *Fuel and the Environment.* (Smart Apple Media, 2008).

"Energy 101: Solar Power," U.S. Dept. of Energy, 2011, last modified Feb 8, 2011, accessed Dec 8, 2016, https://www.youtube.com/watch?v=0elhIcPVtKE.

Energy and Environment News, https://www.youtube.com/watch?v=NDZzAIcCQLQ. Last accessed, Nov 30, 2016.

"Energy 101: Wind Turbines," U.S. Dept. of Energy, last modified Feb. 8, 2011, Accessed Dec 8, 2016. https://www.youtube.com/watch?v=tsZITSeQFR0

GeoScience Video, Coal, Oil and Natural Gas. https://www.youtube.com/watch?v=sQncFcuYWos&feature=youtu.be, last accessed Jan

2016.

Helen Briggs, *50 years on: The Keeling Curve legacy (*BBC, Dec. 2007). http://news.bbc.co.uk/2/hi/science/nature/7120770.stm

History Channel, *Thomas Edision*, last accessed 11/25, 2016. http://www.history.com/shows/america-the-story-of-us/videos/thomas-edison

Lauri S. Friedman, *Fossil Fuels.* (Reference Point Press, 2010).

Magic School Bus, "Getting energized" https://www.youtube.com/watch?v=12ZgGY99Q20, last accessed Nov. 20 2016.

Nathan S Lewis, *Engineering and Science No 2: Powering the Planet* (California Institute of Technology 2007).

Peggy J. Parks. *Wind Power.* (Reference Point Press, 2010).

"Red Clay Elementary Wiki" last modified September, 2016. https://rc-elemscience.wikispaces.com/RC-ElemScience+Home

Richard Komp, "How do solar panels work?" TedEd, accessed Dec 8, 2016. https://www.youtube.com/watch?v=xKxrkht7CpY&t=144s.

Sonia Levitin, Ginger Howard and Sarah Stewart. *Boom Town, William's House and The Gardener,* (Scotts Foresman, 2008),16, 254, 284.

Steve Parker, *Science View: Heat & Energy*, (Philadelphia : Chelsea House Publishers, 2005.)

Tia Ghose, *Nikola Tesla vs. Thomas Edison: Who was the Better inventor?*, Jul 2014 http://www.livescience.com/46739-tesla-vs-edison-comparison.html

Tradequip international, "From ground to car," last accessed Jan, 2016. https://www.tradequip.com/articles/groundtocar

Vaclav Smil, *Energy in everyday life*. (Oneworld Publications 2006).

List of materials for classroom use:
Chromebooks
Worksheets (listed in back). Can be projected or printed out.

Appendix A: Implementing District Standards

School district academic standards in Delaware touch on energy moving by motion, the effects of heat energy as well as electric energy (2.1, 3.1, and 3.2). The main theme of "Energy and Its Effects" is easily broken down throughout this unit to help students see how energy is transferred. First it goes to plants, then gets broken down chemically transferred to other things, when animals or people at plants. They are also broken down by machines into other material and used in their everyday lives, with technology and also how they need energy to move (3.4 objective). This major chunk helps students have a solid foundation of energy for them to go onto other grades with little misconceptions, as energy is taught and reinforced over a semester. This will also touch on the Next Generation Standards of students critically thinking of ways in which we can solve problems.

It would also include an in depth look on the 3rd social studies unit on economics, where one looks at the types of resources. Instead of just clearly identifying everyday resources, one can acknowledge how energy is used. The 3.E1.2. Standard for students identifying the resources people need to function a crucial one touched, when talking about resources one can use. Towards the end of this science unit, civics is indirectly touched, as the 3.C3 standard is for students to realize their sense of responsibility as citizens, in relation to the environment. Throughout, students are dividing responsibilities and needing to work cooperatively in order to participate and learn in hands on activities and discussions which is part of the 3.C4 social studies standard.

Appendix B: Misconception Survey

Misconception survey: Circle whether the statement is true or false.

1.	Within 30 years, there will be no oil left on Earth.	True	False
2.	Fracking is harmful to the environment.	True	False
3.	Once you use energy it's lost/gone.	True	False
4.	Most energy comes from electricity.	True	False
5.	Solar and wind energy is useless because it's inconsistent.	True	False
6.	Nuclear power plants are bad for the environment.	True	False
7.	Energy can be destroyed.	True	False
8.	Energy is the same as power.	True	False
9.	Coal is a mineral.	True	False
10.	The world will run out of nonrenewable resources by 2050.	True	False

All false, explained at different times of the unit.

1. There is plenty of oil underground. Many parts of the world like in China and Russia, we don't know the extent of oil that there is, but we know they have plenty to keep us going for a long time. Some people try to scare people as a way of persuasion through false truths, or misconceptions.
2. There is no evidence showing that fracking is harmful to the environment. In the spring DTI session, the process of fracking was explained. It is where, instead of just drilling straight down vertically, once it comes to a rock bed or well of oil, they have machines now to then go horizontally to get oil in that area. Those who do this make sure they spread to only get oil, not to break into a water supply.
3. Energy is not created nor is it destroyed; it is transferred from one thing to another. A battery may lose its charge, but that doesn't mean the energy disappeared; the energy transferred somewhere else. For example; a phone can heat up when it is being used. As it's being used, the battery is going down, but that's because energy is making the phone work. The energy omitted goes back into the air.
4. Electricity is a product of different forms of nonrenewable and renewable energy. Coal created a large portion of electricity. All energy comes from the sun. While electricity is widely used, the source of its energy can be many resources, including wind, solar, and fossil fuels (Fossil fuels being oil, natural gas, and gasoline).
5. Solar and wind energy are relatively new forms of renewable energy. In this, I mean that there is an endless supply, as the sun doesn't get burnt out from giving us energy (because of the concept that all energy comes from the sun and it is not destroyed but transferred). Wind energy is renewable (see further information in renewable section) and while some places have more wind than others, that's why wind turbines are put 300 ft or more in the air. As the sun and the wind can be inconsistent in certain areas and at different times, the energy harnessed can be used for homes and then sold back to utility companies, for them to use any energy a household doesn't use. While renewable energy made up only about 2% of the world's energy consumption in 2011, it is used more widely in some places and helps lessen the carbon footprint (described in the household energy section).
6. Nuclear power plants are not bad for the environment. With anything, accidents happen, mentioned in the background section, but overall it's gotten safer and the energy output has grown more efficient as time goes on.
7. Energy cannot be destroyed; it may transfer, but it does not disappear.

8. Energy is the not same as power. Power is the level of intensity of how something can work; energy is behind it all though, being the capacity to be able to do work. It transfers and is all around us; force or pressures make power to happen.
9. Coal is not a mineral. Coal is made up of sediments, microscopic organisms and plant life that has been broken down, compressed and heated with intense pressures over millions of years. It is organic; minerals are not organic, they do not come from things like plants, they come from minerals and is a separate part of knowledge.
10. The world will run not out of nonrenewable resources by 2050. Just like the misconception of running out of oil, there is more natural gas to go around than we realize.

Appendix C: Homework for students to recognize their energy usage. Can refer back to this at end of unit or after talking about carbon footprint we put on earth due to our energy consumption.

1. How many minutes in the shower/to fill the tub? _____
2. How many seconds to brush ones teeth? _____
3. Do you turn off the faucet between brushing your teeth? Yes No
4. Do you keep electronics plugged in even after they are charged? Yes No
5. Do you turn off the lights when you leave a room? Yes No
6. On average, how many hours do you watch TV per week? _____
7. On average, how many hours do you play on the computer or tablet? _____

Appendix D: Short Post- test that reviews first part of unit.

Post Test on Energy:

1. All energy comes from…
    a. Plants
    b. Animals
    c. Water
    d. The sun
2. It takes about ___ minutes for the sun's rays to reach Earth.
    a. 1
    b. 8
    c. 24
    d. 30
3. Choose what description talks about the process of refining.

a. To separate oil into its particles, gasoline and other substances, before usage.
b. Harnesses the sun's energy.
c. Turbines capturing the wind.
d. Energy transfers

4. Circle which energy resources are renewable resources.

Hydropower	coal	natural gas	nuclear	
Solar	wind	oil	biomass	

5. Circle which energy resources are nonrenewable resources.

Hydropower	coal	natural gas	nuclear	
Solar	wind	oil	biomass	

6. Explain the difference between renewable and nonrenewable energy.

_____

_____

_____

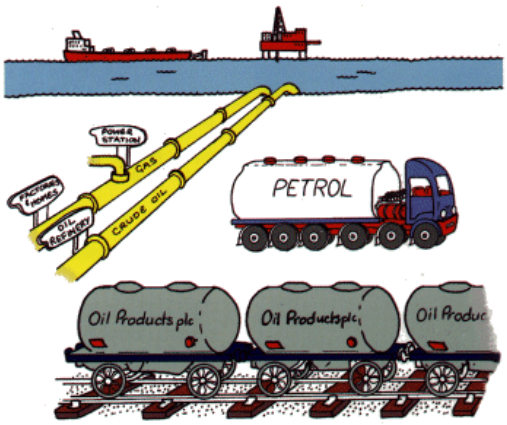
7. Describe how humans use energy in their bodies starting with the sun in relation to plants and animals.

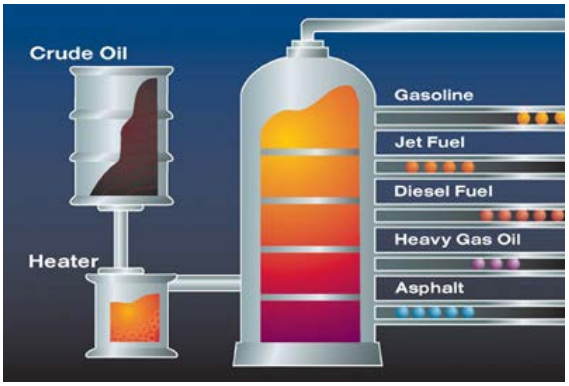
_____

_____

_____

8. Using the pictures, describe the process of how energy is transferred from obtaining oil to having gasoline available to be used for your car.





http://www.world-petroleum.org/edu/222-how-do-we-get-oil-and-gas-out-of-the-ground

Appendix E: Sentence Starters

<u>Sentence starters to discuss about misconceptions…</u>

I once thought the same too, until I learned in class that…

A lot of people think that, but if one looks into the science findings, the scientists say that…

I understand why you might think that, but let me offer what I learned in science class about….

<u>Sentence starters to describe processes</u>
First, the energy ….

Then, it flows to….

The next step is for…

Appendix F
Alternative Energy Note taking:

	<u>Pros</u> **Some positives include…**	**<u>Cons</u>** **Some setbacks may be that…**
Wind power		

Solar power		
Water power		