2015-2016 Kenan Fellows Project LA Hudson

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| Title  | **Electricity: Sources, Usage, Challenges and the Future** |
| Additional Documents | This [Unit Sheet](https://docs.google.com/document/d/1iSWDxJ29OEWVffWhY8gmjyVRc_UqWZCpyC72fjurdNE/edit) details all of the information for each day including timing, resources, handouts, and rubrics.  |
| Introduction  | Most students don’t usually consider the source for electric power that is vital for their day-to-day activities. This lesson unit will provide the opportunity for students to investigate, research, and analyze the steps that transform energy from ‘raw material’ (coal, oil, natural gas, solar energy, wind energy, nuclear energy, etc) to ‘power’ that they use for charging their phones, and using their computers and television. Students will complete a series of inquiry based activities that lead them on a course to discover what really happens when they turn on the lights-- from the site of the mining, collection, or generation to the power plant or point of distribution to the transmission and delivery of electric power to their homes.Students will focus on conservation and the importance of being good stewards of natural resources as well as possible career choices related to electric utilities. Some instructional techniques that will be used in the lesson are:Literacy/writing- there are included articles, videos, and writing prompts that will lead students to discuss implications, causes and effects, and other ideas with each otherInquiry- students will be given a set of items (bulbs/wires/battery) and encouraged to investigate and draw conclusions about the scenario. Students will then be asked to work together to develop a series of questions that can be investigated and/or researched as it relates to electrical energyCollaboration- one of the most important skills students will refine during this unit is their collaboration skills. They will have to effectively communicate with each other in order to craft a complete project or presentation (product) and each individual will be responsible for a portion of the product.  |
| Real Science Application  | As technology continues to evolve our energy sources will change. It is vital that all aspects of energy generation and consumption are analyzed as decisions are made to replace traditional energy sources with alternative energy sources. Global climate change is currently a topic of discussion for many political leaders and scientists. It cannot be denied that fossil fuels play a major role in contributing to increasing carbon dioxide in our atmosphere. Many think that alternative energies are the solution to this problem, however there are many different facets of the problem and the solution that must be addressed in order to develop the best solution. Technologies are currently being developed to reduce the amount of carbon dioxide released by the burning of fossil fuels while new technologies are also being developed to generate, store, and transfer electricity. As new technologies are developed, consumers will have more options for obtaining electricity for their personal, business, transportation, and industrial needs. It is important for consumers to be well educated on the real cost of fossil fuels and alternative energies in order to make the very best choices for the environment and their wallet over the short and long term.  |

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| Curriculum Alignment  | **These lessons are written for use in Earth and Environmental Science and will align with the North Carolina Essential Standards detailed below:**The main standard that will be used is:EEn.2.8.1 Evaluate alternative energy technologies for use in North Carolina.**The following standards are closely associated with this unit and will be referenced during this unit:**EEn.1.1.3 Explain how the sun produces energy which is transferred to the Earth by radiation.EEn.2.2.1 Explain the consequences of human activities on the lithosphere (such as mining, deforestation, agriculture, overgrazing, urbanization, and land use) past and present. EEn.2.2.2 Compare the various methods humans use to acquire traditional energy sources (such as peat, coal, oil, natural gas, nuclear fission, and wood).EEn.2.5.5 Explain how human activities affect air quality.EEn.2.6.3 Analyze the impacts that human activities have on global climate change (such as burning hydrocarbons, greenhouse effect, and deforestation)EEn.2.8.4 Evaluate the concept of “reduce, reuse, recycle” in terms of impact on natural resources**The following Next Generation Science Standards also associated with this lesson:**Standard 2. Influence of Engineering, Technology, and Science on Society and the Natural World, Specifically:* Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications.
* Engineers continuously modify these systems to increase benefits while decreasing costs and risks.
* New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Practice 4. Analyzing and Interpreting Data, specifically:* Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.
* Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success

Practice 6 Constructing Explanations and Designing Solutions, specifically:* Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Practice 7 Engaging in Argument from Evidence, specifically:* Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.
* Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
* Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.
* Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
* Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.
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| Learning Outcomes  | * Students will define the following terms (and be able to give examples of each if applicable): renewable resources, nonrenewable resources, traditional/conventional energy sources, alternative energy sources, nuclear power, fission, fusion, coal, oil, natural gas, petroleum, mining, drilling, electric cooperative, investor owned utility
* Students will be able to describe the advantages and disadvantages of using the following energy sources:
	+ nuclear
	+ coal
	+ oil
	+ natural gas
	+ solar
	+ wind
* Students will develop a deep knowledge of an energy related topic of their choice
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| Time Required, Location and Activities | All of this information is located on the [Unit Sheet](https://docs.google.com/document/d/1iSWDxJ29OEWVffWhY8gmjyVRc_UqWZCpyC72fjurdNE/edit) which allows the teacher to easily view all relevant information for this unit.  |

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| Safety  | This unit has minimal safety considerations. There are no required field activities or labs requiring chemicals.  |
| Participant Prior Knowledge  | The participant should have a basic understanding of the following types of energy: thermal, chemical, mechanical, and gravitational. The participant should have a basic understanding of how energy can change forms. An activity that students can do to review/learn these concepts is [Thermodynamics: Energy and Entropy](https://www.sascurriculumpathways.com/portal/#info/605)The participant should have a basic understanding of global climate change and atmospheric structure.A good review for this is the documentary “An Inconvenient Truth”that showcases some of the issues with fossil fuels and the implications of carbon dioxide on our atmosphere and biosphere.  |
| Facilitator Preparations  | The facilitator will need to complete the following tasks:* Preview all associated videos
	+ [The Path of Electricity](https://www.youtube.com/watch?v=d8kiulPl4ko)
	+ [Solar and the NCEMC](https://www.youtube.com/watch?v=LpvDwkA165Q)
* Review all associated handouts.
	+ See the [Unit Sheet](https://docs.google.com/document/d/1iSWDxJ29OEWVffWhY8gmjyVRc_UqWZCpyC72fjurdNE/edit) for a comprehensive list
* Become familiar with local energy resources and electric utilities
	+ In NC, [Duke](https://www.duke-energy.com/), [NCEMC](http://www.ncemcs.com/about/ncemc.htm), and [Dominion](https://www.dom.com/residential/dominion-north-carolina-power) are the major electric providers along with smaller, local Electric Utilities
* Obtain all materials required (batteries, bulbs, wires)
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| Assessment  | “When one teaches,two learn”. The culminating performance based assessment for this lesson will be the generation and presentation of an energy related topic. Performance based assessments mimic real-world situations where individuals learn about a topic and then make a decision or share information based on their learning, and in this instance, bring in the community to broaden impact and reach more individuals.  Students will choose a topic to research OR develop a product that illustrates an energy-related concept and conduct extensive research to develop a presentation that they will share during a science-fair like event where members of the community will be invited to view projects and have discussions with participants. There is more information and a list includes some (but not all) possible ideas for projects on the unit sheet. There is also a rubric included on the unit sheet. The goal of this assessment is two fold: students will practice good research techniques by evaluating resources and compiling information; they will then assemble information into a visually appealing and informative presentation, poster, brochure, or product. The final product will be shared with individuals who have limited science background and may have very little knowledge of energy topics outside of their personal experience with electricity. The presentations will serve to educate the general population in topics like alternative energy, energy efficiency, and consumer behavior to reduce electricity bills. This will allow students to ‘give back’ to the community-- everyone can benefit from more education about energy conservation; from customers who will enjoy lower bills because of energy saving efforts to the utility companies who experience less demand due to conservation.  Rubrics, sample sign up sheet, and more information is located on the [Unit Sheet](https://docs.google.com/document/d/1iSWDxJ29OEWVffWhY8gmjyVRc_UqWZCpyC72fjurdNE/edit?usp=sharing)  |
| Extension | **Unit Activities:** If time allows, there are valuable resources located at SAS Curriculum Pathways. * [Electric Power and Energy Efficiency](https://www.sascurriculumpathways.com/portal/#info/604)- This activity allows students to analyze power usage and cost; students will also perform an energy audit on their home and examine how ‘Energy Star’ Appliances can save money.
* [Natural Resources: Petroleum](https://www.sascurriculumpathways.com/portal/#info/434)- Students investigate sources of petroleum and determine the steps needed to refine petroleum into a usable product.
* [Nuclear Power- Pro’s and Con’s](https://www.sascurriculumpathways.com/portal/#info/632)-This lesson provides students with the opportunity to create a short presentation as they research the possibility of a nuclear power plant in their town and make a recommendation to the ‘town hall’.

**Guest Speakers:** Guest speakers who work in the industry always provide an interesting opportunity for students to get a first-hand glimpse into careers and opportunities. Possible speakers for this unit include:* Electrical engineers
* Electric Utility personnel- linemen, engineers, technicians, etc.
* Professors of engineering, natural resources, physics
* Professionals that work at power plants (nuclear, coal, etc)
* Professionals that develop renewable energy resources

You can email or call the local utitlitie in your location and make contact. The following websites would have relevant and helpful information * + [Duke](https://www.duke-energy.com/)
	+ [NCEMC](http://www.ncemcs.com/about/ncemc.htm)
	+ [Dominion](https://www.dom.com/residential/dominion-north-carolina-power)

**Field Trips:**Anytime that funds and time allow, a trip to see what students have been learning will further engage the learner even more. Some possible ideas are:* Power Plant (there are some limitations due to safety)
* Solar Farm

**Project:**Some students may have an advanced skill set, special interest, and available resources to create a completely new and functioning project from scratch. Encourage these students to use internet sources to find Do-It-Yourself energy projects.  |

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| Critical Vocabulary  | **alternative energies:** fuel sources that do not rely on fossil fuels or create CO2 as a result of their use. **fossil fuels:** fuels derived from the remains of living things that have been compressed over millions of years into a carbon rich fuel form. Fossil fuels release CO2 into the atmosphere when burned as a fuel source. stewardship: the concept that humans are ultimately responsible for the activities that they participate in, and they should take special care to ensure that resources are not haphazardly used and discarded. **traditional/conventional energy sources:** fuels that have been used for many years and typically involve combustion and the release of CO2 into the atmosphere (coal, oil, natural gas, biomass)**Nuclear energy:** the energy in the nucleus, or core, of an atom. Atoms are tiny units that make up all matter in the universe. Energy is what holds the nucleus together. There is a huge amount of power in an atom's dense nucleus.**coal:** a combustible black or brownish-black sedimentary rock usually occurring in rock strata in layers or veins called coal beds or coal seams**oil/petroleum:**Petroleum is a naturally occurring, yellow-to-black liquid found in geological formations beneath the Earth's surface, which is commonly refined into various types of fuels**natural gas:** a [fossil fuel](https://en.wikipedia.org/wiki/Fossil_fuel) used as a source of energy for heating, cooking, and electricity generation**solar energy:** a broad term that refers to using energy from the sun for heating and electrical purposes**wind energy:** the use of windmills to turn a generator for [electrical power](https://en.wikipedia.org/wiki/Electrical_power).**tidal energy:** a form of hydropower that converts the **energy** obtained from **tides** into useful forms of power, **geothermal energy:** heat energy generated and stored in the Earth.**hydroelectric power**: the production of electrical power through the use of the gravitational force of falling or flowing water**electric grid**: an interconnected network for delivering [electricity](https://en.wikipedia.org/wiki/Electricity) from suppliers to consumers. **smart grid:** an [electrical grid](https://en.wikipedia.org/wiki/Electrical_grid) which includes a variety of operational and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficiency resources |
| Community Engagement  | Students will present their work at an ‘Energy Expo’; students will present their particular area of research in a science fair format. The community will be invited and have the opportunity to ask questions. This will generate an awareness of energy use and possible future solutions for local utilities. Members of the community will be able to meet with electric utility individuals at that time and ask questions, or set up an energy audit. This event will be held during the evening so that parents are able to attend. There may be some challenges setting a date due to high school athletics, but the event could possibly be held on a night there is also a PTA/PTO meeting or during parent conference. The event should last no longer than about two hours. **Publicity**- Since community members are invited and encouraged to attend, they need to know about the event. Some ideas for advertising include:* Students will be responsible for reaching out and inviting at least 10 people. They will have an [invitation sheet](https://docs.google.com/document/d/1yxdnVuP3NbNzqntx69NarJ-EJwNYFbrS-4ZFpnzOh-4/edit?usp=sharing) that they have to complete.
* Many news stations do community spotlight segments- encourage students to contact the news station to see if they could advertise the event.
* Invite a student to write a ‘Letter to the Editor’ describing the benefit of attending the Energy Expo for local community members.
* Include the event on the school sign and website and social media

**Setup-** I recommend securing space in either a media center, cafeteria, down a hallway, etc. where tables can be set up for students to display their projects. There should be enough space between tables to allow visitors to ask question and discuss topics with students. Depending on the time of year, there may be some groups that want/need to present outside. Our school has a courtyard, this will need to be handled on a school-by-school basis. **Final Remarks-** Students will engage in conversations with community members to dispel myths about fossil fuels and alternative energy and also educate the community on how local solar farms impact the electric grid. Guests should leave with a clear picture of how the electric grid works, careers in the electricity industry, and a strategy for lowering their electric bills. You may want to have a survey for guests to complete (either paper or online) to improve your next event.  |
| References | [Final Project Rubric from The Buck Institute for Education](http://blog.discoveryeducation.com/wp-content/uploads/2013/05/HS_Presentation_Rubric_for_PBL_FINAL2013_1.png)Extension Activities through [SAS Curriculum Pathways](https://www.sascurriculumpathways.com/portal/)Alternative Energies Powerpoint from [Teacherweb.com](http://teacherweb.com/)[‘Batteries, Wires and Bulbs’](http://ubclts.com/docs/Inquiry-Based_Electricity.doc)  |
| Author Info  | Leigh Ann Hudson is in her 12th year of teaching in eastern NC. Her project was titled ‘It’s Electric!’ and focused on the electrical system in North Carolina, specifically through NC Electric Cooperatives. Mrs. Hudson can be reached at LHudson@martin.K12.nc.us.Mentor:Monica Speight is communications specialist at Edgecombe-Martin Electric Membership Cooperative. Monica has a degree in business administration. She can be reached at monicast@ememc.com. |