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| **Title** | Energy: Follow the Flow- From the Powerhouse to Your House |
| **Introduction** | The production of energy has always been complicated and also one of the most invested business that mankind has undertaken. We have enjoyed the benefits of energy for quite some time and more often than not take it for granted. According to the Department of Energy, the United States consume 3,886,400,000 MWh/yr, which is second to China (in the number one position) who has double the population of the US.  The flow of energy has always been fascinating to follow. From the production to the distribution and to the consumption we can find out how the flow happens, how much of the energy produced was distributed all throughout and also how much was lost in the process. In this lesson, students are going to use data from the Department of Energy, Halifax EMC and their electric bill to understand where we get our electricity, how it comes to our houses, and how much electricity they are using in a given period of time. Students will also learn what they can do to conserve electrical energy. They will also make research based analysis and come up with their own solutions to solving efficiency in the transformation, distribution and consumption of energy. |
| **Real Science** | We have always studied the different forms of energy and all its effect to the environment. We focus on the production and then the consumption and its environmental effects but not much emphasis is given on the distribution parts. In this project I would like the students to understand how energy is transformed and delivered to the ultimate users to make them more appreciative of energy and hopefully in the process make them a good and conscientious citizen in using energy. If students are able to understand the system in place that works together to make better service and distribution possible then they would have a better understanding on how we enjoy this energy from production up to consumption. The knowledge that they would gain through research will be put in place in the project that they will have to present at the end of the unit. |

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| **Curriculum Alignment** | This Lesson is made for 8th grade students but can be extended to 6th, 7th and High school grades.  NC Essential Standards   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Content Area | Grade Level | NC SCS | Sources of Energy | Diorama of Power plant | | Science | 8th Grade | 8.P.2.1 | X | X | | Physics | HS | Phy 2.3 & Phy 3.2.2 -3 | X | X |   NGSS   |  |  |  | | --- | --- | --- | | Disciplinary Core Ideas  PS3.A | Sources of Energy  X | Diorama of Power plant  X |   Common Core Standards   |  |  |  | | --- | --- | --- | | Content Standard | Sources of Energy | Diorama of Power plant | | CCSS ELA LITERACY R.1.8.1CCSS ELA Literacy.R1.8.1 | X | X | | CCSS ELA LITERACY R.1.8.2CCSS ELA Literacy.R1.8.2 | X | X | | CCSS ELA LITERACY R.1.8.3 | X | X | | CCSS ELA LITERACY R.1.8.8 | X | X | |
| **Learning Outcomes** | Students will be able to identify the different sources and uses of energy.  Students will be able to tell the difference between renewable and non-renewable energy source.  Students will be able to know how different power plants work.  Students will compare and contrast the different sources of energy and their effects to the environment.  Students will be able to know how electricity is being distributed through electric companies or coops using GIS (Geographic Information System).  Students will be able to make a project to show how they think they can make energy distribution more efficient and environmental-friendly.  Students will know the different STEM careers associated with the production, transformation and distribution of energy. |
| **Time Required and Location** | **Two Weeks**  ***LESSON 1 SOURCES OF ENERGY***  50 minute class period in classroom on day 1:  Sources of Energy: Renewable Resource: Solar, Hydro, Biomass, Geothermal and Wind  50 minute class period in classroom on day 2: Sources of Energy: Non-Renewable Resources: Nuclear & Fossil  50 minute class period in classroom on day 3: Distribution of Energy and How Power Plants Work  50 minute class period in classroom on day 4: Different forms of Energy and their environmental impact – student research  50 minute class period in the classroom on day 5: Presentation of Research/Evaluation  ***LESSON 2 DIORAMA OF POWER PLANT***  50 minute class period in the classroom for days 1-5 for the construction and presentation of the Diorama project |

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| **Materials Needed** | Teacher List   * Computer/Chromebook * Projector * iPod touch or phone with the QR code reader * Gallery Walk Day 1 & 2: GALLERY WALK * Answer sheets: Answers Day 1: HOW WE USE AND MAKE ENERGY, Answer Day 1: INTRODUCTION TO ENERGY, Answers Day 3: FROM THE “POWERHOUSE” TO YOUR HOUSE, Answers Day 4: ENVIRONMENTAL IMPACT OF ENERGY PRODUCTION, and Answers Day 5: Energy Quiz   Student List   * Student worksheets (1 per student): Day 1: HOW WE USE AND MAKE ENERGY, Day 1: INTRODUCTION TO ENERGY, Day 1 & 2: SOURCES OF ENERGY, DIORAMA PROJECT GUIDELINES & RUBRIC, Day 3: FROM THE “POWERHOUSE” TO YOUR HOUSE, Day 4: ENVIRONMENTAL IMPACT OF PRODUCTION OF ENERGY, Day 4: ENVIRONMENTAL IMPACT OF ENERGY PRODUCTION slides, and RUBRIC FOR THE ENERGY SOURCE PRESENTATION. * 1 computer for every student * printer * iPod touch or phone with the QR code reader * Large piece of cardboard for each diorama group * Materials for diorama: recycled materials, boxes, plastic tubes, scrap wood, scissors, glue, paste, solar panels (if needed), wires, batteries, diodes or Christmas lights, batteries, toys and many other scrap materials. |
| **Safety** | Students are expected to follow guidelines and rules in the classroom and the computer lab.  There are no special equipment to be used in this lesson and thus the usual classroom and lab rules in place will be followed. |
| **Student Prior Knowledge** | This activity is part of the unit for the Sources of Energy. Students should already know conductors and insulators and circuits to be able to understand fully the concepts of how electricity flows and distributed. |
| **Teacher Preparations** | * Become familiar with technology tools students can use for their project (Glogster, Popplet, Padlet and also Google docs. * Reserve computers (chrome books) for this lesson. Reserve also iPod touches or if possible let the students use their own device. * Prepare a Rubric for their project and the handouts (included) |
| **Activities** | **Unit: ENERGY AND ITS IMPACT TO THE ENVIRONMENT**  **Time-frame: 2 weeks**  ***LESSON 1 SOURCES OF ENERGY***  **Time-frame of Lesson 1: 1 week**  **Day 1 –Sources of Energy**  Catalyst Question: What is/are the source/s of Energy that we are using here in Warren County?  This question will serve as an introduction and also will gauge the awareness of the students towards Energy and Energy use. Since this is the first day for the topic, many of the students may not be able to correctly answer the question. Teacher will write down the answers on the board given by the students and will take note of the responses BEFORE the lesson. At the end of the day, the teacher will ask the same question and go back to the result and compare if there is any change in their responses. (10 minutes)  **Individual Work:** (15 minutes)  Students will be given the handout HOW WE USE AND MAKE ENERGY. They will have to answer some questions and take down notes while watching a two-minute video  **Group/Paired Discussion: Energy Source** (25 minutes)  Divide the class into 9 groups according to Energy source: Nuclear, Petroleum, Natural Gas, Coal, Hydroelectricity, Sola, Geothermal, Biomass and Wind. This activity can be done in pairs or in groups depending on the number of students in the classroom. (Use DAY 1 & 2: GALLERY WALK DISPLAY)  Pass the handout INTERMEDIATE ENERGY INFOBOOK from the website  <http://www.switchenergyproject.com/education/CurriculaPDFs/SwitchCurricula-Intermediate-Introduction/SwitchCurricula-Intermediate-EnergyInfobook.pdf>  They should also be given the INTRODUCTION TO ENERGY Worksheet.  Give the students time to fill-in parts or answer questions by working with the group (or partner) assigned to them. All the groups will work on the Introduction to Energy page.  Give them the SOURCES OF ENERGY worksheet. On this worksheet, they will work ONLY on the assigned energy source.  Teacher will clarify misconceptions and monitor the work of each group.  **Exit Ticket**  Go back to the catalyst question and write the answer on a piece of paper and give it to the teacher. Through this exit ticket, the teacher will be able to tell how much the students learned about the sources of energy and the kind we use locally.  **Day 2 – Sources of Energy**  Catalyst Question: .(5 minutes)  What is the main difference between renewable and non-renewable energy? What do you think is the form of energy that we use the most and why?  **Teacher-Led Discussion:** Ask volunteers to answer the question. At the end of the activity, the whole should come up with the correct answer with the guidance of the teacher  **Group Discussion: Energy Source**  **Station/Gallery Walk**  Continue with the work they have started the previous day. This time however they are going to do the gallery walk (Use DAY 1 & 2: GALLERY WALK DISPLAY) and get the information from each gallery. Allow them to write their answer on a display board (paper) that they can post at a designated station in the classroom. (10 minutes)  Once the students have posted all their display board on their designated stations they can now move from station to station to get the information they needed for the other energy source. Allow at least two minutes per station. (20 minutes)  **Presentation Preparation: (15 minutes)**  Students will be allow to work in groups to begin completing ENVIRONMENTAL IMPACTS OF ENERGY PRODUCTION slides. Students may also begin planning what they will say during their presentation.  Time for the planning and working on the project will be given.  Exit Ticket: Which do you think of all the energy sources discussed is the most environmental friendly and why?  **Day 3 – Production, Distribution and Transformation of Energy**  **Catalyst Question:** How do you think electricity gets to your house?  **Teacher-led instruction (15 minutes)**  As an introduction for the day’s lesson, students will watch a slide show on a hydropower plant. (This is a presentation of the teacher’s summer internship with Halifax Electric and Lake Gaston Chamber of Commerce.)  <http://bit.ly/1vLPIqj>  Teachers can use another video to make the introduction on How a Power Plant Works  <http://www.oresomeresources.com/media/flash/interactives/coal_fired_power_station/>  **Individual/Paired Work (30 minutes)**  Students will be given a worksheet FROM THE “POWERHOUSE” TO YOUR HOUSE and will watch short videos and fill-in the information needed. This activity can be done individually or with a partner.  **Exit Ticket**  Students will put in a simple diagram using boxes and connectors how electricity is delivered from the “powerhouse” to their house.  **Day 4 Environmental Impact of the Production of Energy**  Catalyst Question: Which do you think is the most environment-friendly of all the energy productions?  **Teacher-Led Instruction: (5 minutes)**  Students will provide the answer to the question and with the aid of the teacher the whole class will come up with the generalization that using Solar Energy is the one that has the least environmental impact.  **Individual Work: (15 minutes)**  Give each student Day 4: ENVIRONMENTAL IMPACT OF PRODUCTION OF ENERGY worksheet. As an introduction to the lesson students will watch a short video on **Environmental Impacts** and **Energy Choices**  <http://www.switchenergyproject.com/education/energy-101>  **Group Work: Environmental Impacts on Google Presentation (30 minutes)**  Using the same grouping from the previous activities, students will work together on the environmental impacts of producing energy. There will be 9 groups, one for each energy resource (Natural Gas, Coal, Oil, Nuclear Energy, Hydroelectricity, Solar, Geothermal, Biomass, and Wind).  Students will visit the Environmental Protection Agency website to get the information needed.  <http://www.epa.gov/cleanenergy/energy-and-you/affect/index.html>  A Google presentation template (Day 4: ENVIRONMENTAL IMPACT OF ENERGY PRODUCTION slides) will be shared to everyone and they will be able to edit the assigned slide. At the end of the given time, all the students will have access to the whole class work of all the environmental impacts of different energy sources. This will serve as a collaborative class project.  If doing this activity is not possible using the computer, the teacher can print the template and give to each group assigned. A handout is also made available for all the students.  **Exit Ticket**  What are the four criteria in choosing the right energy choice? (As seen on the film)  **Day 5: Reporting and Evaluation Day**  **Catalyst Question: Can be projected by using a Google Presentation.** (5 minutes)  Based on what you have learned yesterday about the energy source assigned to you, does your energy meet the four criteria for choosing an energy source? Rate only your assigned energy source in the Day 5: CRITERIA FOR CHOOSING AN ENERGY SOURCE.  At the end of the discussion the whole class can see a better picture of all energy source.  **Option 1**  **Group Report: Environmental Impacts of the Production of Energy (35 minutes)**  Each group will be given 4 minutes to present their slide to the class (2 minute video and 2 minute presentation). At the end of the presentation, all the students should have all the information they needed (online slides) or handouts.  **Evaluation:**  The evaluation will be based on the presentation of the students using RUBRIC FOR THE ENERGY SOURCE PRESENTATION.  **Exit Ticket:** After the discussions of all kinds of energy source, we know we cannot rely on just one source. If the decision is up to you, which is your best three pick and why?  **Option 2**  Teacher Report: Instead of the students reporting the final slide presentation made by the whole class, the teacher will be the one to report it in class, make comments, clarification and changes if necessary. (5 minutes)  **Evaluation:**  A quiz (Day 5: ENERGY QUIZ) will be given to the students. (25 minutes)  At the end of the quiz they can be given time to talk to their group members about the project.  ***LESSON 2 DIORAMA OF POWER PLANT***  **Time-frame of Lesson 2: 1 week**  **Making of the Diorama Project**  The final project will be in a form of a working model of a hydroelectric power plant or a solar power plant. Students will have the chance to brainstorm, gather all the information that they would need, together with the materials necessary and then build in the classroom. Students will be able to play the role of scientists and engineers in making this project. They will also use the Engineering Design Process in making this project. Students will use the DIORAMA PROJECT GUIDELINES AND RUBRIC.  **Project Objective:** To be able to make a working model of different energy resources that can be used locally.  **Materials:** recycled materials, boxes, plastic tubes, scrap wood, scissors, glue, paste, solar panels (if needed), wires, batteries, diodes or Christmas lights, batteries, toys and many other scrap materials.  **Day 1: Planning Period**  **Group Work**: Students will have to work on the groupings used last week or they can combine groups and make new groupings.  **Task: Planning & Making a Schematic Diagram**  Students will have access to the computer to research on the best design they would need to make based on their energy source. They would download a Google map of Warren County and plan accordingly on how and where to put their power plants.  Submission of Diagram  At the end of the day, each group will have to come-up with a diagram on how they will layout their project on a piece of a cardboard measuring 24 x 24 inches to make the diorama. Teacher can provide for the board. Old science fair project boards can be recycled and used for this.  **Day 2-3: Construction of the Diorama**  The whole period will be used to construct their diorama. The members of the group should have brought in all materials.  Teacher will have to monitor the work of all the students. She should also make sure that safety precautions are followed while working on a project.  **Day 4: Testing and Redesigning**  On this day, students will have the diorama already in place. They will now attach the circuit with the help of the teacher. All circuits can be made using old Christmas lights and battery. If the diorama can work without the battery then the batteries will not be necessary.  If something does not work, they can redesign and finalize their project.  One student from the group will have to start editing and answering questions on the template given by the teacher for their report.  **Day 5: Presentation of the Diorama & Evaluation**  Students will use the template for the presentation and the rubrics may be shared via Google forms for them to use and evaluate each other’s project. |
| **Assessment** | Rubrics will be used for assessing (1) the oral presentations and (2) the displays/products for community outreach.  Knowledge of energy sources, transformation, distribution and environmental impact will be assessed by formative assessments (listening to group talk, write to learn exercises, etc.) and by questions included on quizzes and tests (attached).  1. RUBRIC FOR THE ENERGY SOURCE PRESENTATION  2. DIORAMA PROJECT GUIDELINES & RUBRIC |

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| **Critical Vocabulary** | Renewable – energy source that can last for a long period of time  Non-renewable – energy source that cannot be replenished and will run out  Fossil Fuels – fuels that include oil, coal, and natural gas that is formed from the remains of prehistoric dead animals  Biomass – biological material derived from living, or recently living organisms.  Solar energy – energy generated from the sun  Nuclear energy – is the use of exothermic nuclear processes to generate useful heat and electricity. |
| **Community Engagement** | As a kick-off for the STEM AFTER-SCHOOL PROGRAM in our school, selected students from my class gave a presentation of their project to the Superintendents, Principals and Teachers from the neighboring schools and school districts. In attendance also were representative from NCSU Department of Education. They are the main sponsors of our STEM After-School Program.  I have also invited two speakers from Halifax EMC during our STEM Career Talk last October 31, 2014. |
| **Extension Activities** | Students can try to calculate the carbon imprint of the whole county the school is in. Use the following website:  <http://www.nature.org/greenliving/carboncalculator/>  <http://www.carbonfootprint.com/calculator.aspx>  They can also try to find out how “green” the school is and come up with an action plan to make the school greener. (Source: <http://www.greenschools.net/form.php?modin=53>)  Students can make a diorama of their chosen energy project and show how it would work locally. It should show the area where the proposed power plant should be placed and how it can be distributed locally. |

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| **Modifications** |  |
| **Alternative Assessments** |  |
| **References** | Bryson Education  http://www.brysoneducation.org/teachers/support\_materials/energy\_worksheets.asp  ThinkQuest: The Shocking Truth About Electricity  <http://wayback.archive-it.org/3635/20130919171729/http://library.thinkquest.org/6064/>  Department of Energy  http://energy.gov/science-innovation/energy-sources  The Switch  <http://www.switchenergyproject.com/>  Shell: Global Future of Energy  <http://www.shell.com/global/future-energy.html?gclid=CNLwsKrLpbgCFcvm7AodigYAYQ>  USGS Energy Resources Program  <http://energy.usgs.gov/GeneralInfo/AbouttheEnergyProgram.aspx>  Halifax Electric Membership Corporation  <http://www.halifaxemc.com/home/index.aspx>  Touchstone Energy  <http://energysavings.togetherwesave.com/index.php>  Environmental Protection Agency  <http://www.epa.gov/cleanenergy/energy-and-you/index.html> |
| **Supplemental Information** | ***This is the video slide show of my students working on their project, presenting and grading each other.***  [***https://animoto.com/play/tyKGKKHdLBACapijCYSYIQ***](https://animoto.com/play/tyKGKKHdLBACapijCYSYIQ) |
| **Comments** | * Energy sources can be taught with the extension activities to make the unit more hands-on * If making the final project is not possible, the handouts can also be used for the Energy portfolio without having to spend a day or two more on the final output. * Students like it more when they are the one trying to come up with an answer to questions instead of the teacher giving them all the answers. It is with this experience that I am giving them more opportunity to learn on their own from their own research and discussion with peers. * Students love seeing the final output of their learning. |
| **Author Info** | Kenan Fellow: Cicelia Aguilar   * Warren County Middle School, Warrenton NC 27589 * 8th grade Science * 17 years of teaching * caguilar@warrenk12nc.org   Mentor:   * Halifax EMC: Julia Allsbrook/Brady Martin & Lake Gaston Chamber of Commerce: Christina Wells * I am working with the Lake Gaston Chamber of Commerce in updating their records and collecting data for them to find out the number of residents (part-time and full-time) and how it affects the economic growth around Lake Gaston. Lake Gaston subdivisions are members/customers of Halifax Electric, which is directly affected by the economic growth along the Lake. * Halifax Electric Membership Cooperative service areas around Warren County. They are also the one serving the Lake Gaston area and its residents. Housing projects are on going around the lake. Private residential homes are being built and new electric grids are being added. Halifax EMC would like to see more growth in the area to add up to the efficiency of the distribution of electricity in the area. This company delights in bringing the Electric Cooperative to the schools by giving Career talks and providing jobs to the locals in the community. |