Solar Energy for Life

Section of Lesson	**Students will be taken on a short tour of the Iditarod Race held up in Alaska. They will be working on a solar warmed shelter for one of the mushers who is stranded on the course**
Title	Solar Energy for Life
Introduction	It began with 2 children that died of diphtheria in 1925. In order to avoid an epidemic and save more children's lives, 20 of the best mail carrier musher teams were used to carry an antitoxin from Anchorage to Nome, Alaska. The only way to get the antitoxin was to use Iditarod Trail, also known as the Seward-to Nome Mail Trail. This "Race for Mercy" was completed in 5 days and 7 hours. The children were treated and an epidemic prevented. In 1973, the Iditarod community and health community elected to have the annual race in memory of this first run. The "Last Great Race" is as we see today. When on the trail, mushers and dogs are constantly threatened by the cold. Sometimes this may lead to them being stranded or even death. Most mushers have an S.O.S. signal if they need to be rescued; however, the musher needs to be able to keep warm and safe until help arrives. Mushers often have a packet of survival gear to use in emergency situations. When stranded they will need to build a shelter and quickly. In this lesson students will use different types of materials to collect Solar Energy to stay warm and protected. The project will introduce the different ways to collect solar energy. The students will be researching information about The Last Great Race, how solar energy works, the materials they are given, and how long the musher and dogs can be out in the elements before suffering from a serious injury.
Real Science Application	Understanding the different weather conditions along the Iditarod Trail, will bring better understanding to the populace on what the mushers go through on the trail. Knowing the environment will help students understand the dangers of the trail. Knowing dangers will help protect the musher from permanent damage. This information will be useful for the students to construct a safe shelter for mushers (and dogs?)

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Curriculum Alignment

This section contains the curriculum alignment of the lesson to the North Carolina NC Essential Standards of Science or Math, and the Next Generation Science Standards (NGSS) or Common Core Math.

Content Area	Grade Level	NC Essential Standards	NGSS / Common Core Math
Physical Science	10th	PSc.3.1.1 Explain thermal energy and its transfer.	
Physical Science	10th	PSc.3.1.2 Explain the law of conservation of energy in a mechanical system in terms of kinetic energy, potential energy and heat.	
HS: Geometry	10th		CCSS.MATH.CONTENT.HSG.MG.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
HS: Geometry	10th		CCSS.MATH.CONTENT.HSG.MG.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
HS: Geometry	10th		CCSS.MATH.CONTENT.HSG.MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Learning Outcomes

Students will understand the history of the Iditarod Race and why it is held annually.
Students will express an understanding of the Engineering Design Process.
Students will design a shelter for a musher stranded on the trail using only the materials provided.
Students will understand how diphtheria can go from patient zero to an epidemic.
Students will describe what heat transfer is and what the three basic forms of heat transfer are.
Students will describe heat versus temperature based on experimental observations
Students will work in teams to satisfy a design scenario
Students will explain how wind chill affects temperature

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Time Required and Location	80 minute class period in classroom on day 1 for research and understanding the assignment. Addition 80 minute class period to build and present.

Materials Needed	Teacher List:
	
	- Iditarod Engineering Design Process Powerpoint (teacher resource folder)
	- Iditarod History (student resource folder)
	- Solar Oven: Specific Directions(located in teacher resource folder)
	- Filled gallon bags for students. See Student List for specific items
	- Thermal Crystal design background
	- copies of student group packets to help with information
	- copies of Iditarod maps (located in Student resource folder)
	  - I suggest laminating the maps to help students decide where they are going to camp.
	- Liquid Thermal Crystal papers to help the students understand the different aspects of the project.
	  - I would order different types of the papers to turn color in the different temperatures.
	  - Links to buy papers. (scroll to the bottom)
	- 4 Heat Lamp with clips
	- 15-20 alligator clips
	
	Student List:
	
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	- Emme's Shelter building directions (located in student resource folder)
	- The following items will be in a gallon bag: The amount of bags will vary with the amount of groups you have.
	  - A Iditarod map
	  - A sandwich bag
	  - A t-shirt
	  - An energy bar wrapper
	  - Tarp 3' x 3'
	  - Popsicle Sticks: 15-20
	  - Thermometer
	  - Each group will receive an expo marker
	  - Liquid Thermal papers (paper that changes in different types of degrees.
	- Students will need their notes they need to take from EDP design powerpoint.
	  - Discussion and Research Student
	  - Student Research provided

Safety	Safety things to look at: - Lamps are hot - Watch out for power cords - Use alligator clips to help with making sure cords are out of the way. - Teacher will set-up lamp

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Student Prior Knowledge	Students should know:
	- About the Engineering Design Process
	- Solar Energy:
	  - For review use the Student Research
	  - How it can be collected
	  - What materials are important for energy collection
	  - Best placement for solar panels on the house
	  - If building a house how would you place your house to get the best solar power

Teacher Preparations	● Prepare filled gallon bags as listed under Student Materials ● Set-Up of Heating Lamps: o You will need lamps that clip to the stands that you set-up around the room. There will be four different stations. The stands can be the edge of tables or the backs of chairs. Using the edge of tables will be more efficient and stable. Use Alligator clips to help maneuver the cords around. ● Make sure you have student packets printed and copied out ● Teacher will need to print out discussion questions with answers. Which are located in the teacher folder. The questions are in the power point. ● If you are having problems with finding equipment to use to determine the solar power, you can use the following apps to help you with figuring this out: o I-phone apps: Free apps that can be downloaded onto phones or ipads if the school has access to these items. ▪ Ohmulator Solar checker ▪ SolMetric ▪ SunFinder ▪ Sketchbook 7 Websites and Resources: Solar Basics Energy for Kids-U.S. Energy Information Administration http://www.eia.gov/kids/energy.cfm?page=electricity_home-basics Solar and Photovoltaic cells -U.S. Department of Energy energy.gov/energysources/solar.htm Flat Plate Photovoltaic Systems -U.S. Department of Energy eere.energy.gov/basics/renewable_energy/flat_plate_pv_systems.html Solar Energy by cooler planet solar.coolerplanet.com
Activities	First 10 minutes of class: Activating strategy: Energy Resources: Think Pair Share (student's resource folder): Students will already be placed in their groups. ● Students will be reviewing from the day before about solar energy and how it works. The activating activity will be used as a review and to transition them into the next section. Discussion Time 40 - 50 minutes: - STUDENT RESEARCH: (25 min):

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	- Next 20 minutes: for the students to look up answers and write them down: 20 - 30 minutes to discuss the different sections: Discussion Questions and Research - Review over Iditarod race and race route. Each group will be assigned a different section of the race to be "stranded". Emme/Emily Iditarod student work packet - Make sure to remind them about the engineering design process. Follow the EDP paper - Directions are under Day 2: Solar Town: Emily Alaska Scenario - Each group will have materials already on their desk. The materials will be in gallon plastic bags. Extra materials will be on the table for students use if needed. - Student's resource will be in Student's resource under Emily alaska project. - Students will have background about the IDITAROD race and thermal crystals to relate back to and understand the information. - Maps for the students will be printed off. You the following website to check on weather conditions http://iditarod.com/race/weather/ - Use the distance in mileage to help see where Emily will be. - http://iditarod.com/teacher/maps/ - The questions will be on a Iditarod powerpoint to help facilitate the discussion. Have the students write down questions and answer them separately. This way it will help make the discussion - Teacher will be giving out maps of for the Iditarod for the different groups - Questions to ask during discussion: - How cold does it get in the area you are "stranded" at night? - What materials from your kit would you use for the your shelter? - How do you think heat and temperature are related? - What type of heat transfer was experienced in this activity? - Why do you think these materials worked best? - Did you expect these materials to work best? Why or why not? - Do you think the idea of trapping radiation/heat is used in engineering today? - If you were going to build a structure to try to keep heat out, which materials would work best? Why? Emme Challenge: 20 minutes: Last part of the class part 1 and 20 - 40 minutes into Day 2: - Teachers will pass out the Emme Challenge paper for the students to go over and work on. - The students will be working on the Challenge paper for 10 minutes. - After the ten minutes teacher will start discussing the paper assignment challenge to understand what other aspects the students will need more information on. - Included in this challenge will be an assignment to go over the Liquid Crystal Thermal papers to have students understand how to use them. - Make sure to remind them about the engineering design process. Follow the EDP paper - Directions are under Day 2: Solar Town: Emily Alaska Scenario - Each group will have materials already on their desk. The materials will be in gallon plastic bags. Extra materials will be on the table for students use if needed.

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	• Student's resource will be in Student's resource under Emily alaska project.
	  ○ Students will have background about the IDITAROD race and Liquid thermal crystal paper to relate back to and understand the information.
	  ○ Maps for the students will be printed off. You the following website to check on weather conditions http://iditarod.com/race/weather/
	  ○ Use the distance in mileage to help see where Emily will be. http://iditarod.com/teacher/maps/

Assessment	• The students will have summative assessments throughout the projects through discussions and group work.
	• The following rubrics will be given to students: (rubrics will be in a folder in the teacher resource folder for the teacher to pull when needed)
	  ○ Emme challenge build
	  ○ Iditarod discussion
	  ○ Liquid Thermal Crystal Review
	  ○ Presentation about the Emme
	  ○ Peer review of Presentation

Extension Activities	The following exercises you can use to Extend the assignment further. You could use these to help differentiate the lessons • PV Cell Introduction (the information and lesson plan will be in teacher resources) • Try your Hand at Nano (the information and lesson plan will be in teacher resources)
Modifications	Lower Grade Students/Individual Education Plan: To help students with the reading the teachers can use the following website to help guide them with the readers: • http://www.readworks.org/rw/k-12-paired-texts-question-sets • http://www.educationworld.com/a_lesson/lesson225.shtml If there is a group that has more students that have IEPs you need will need to be helping them with the projects or even design an example then help them with the project. High/Gifted Students: Have the students build shelters for the dogs as well. They will need to design the shelters to help dogs keep the warm and safe. They will not be given any more materials than they already have been given. They will need to conduct a presentation of both the dog shelter and Emme shelter. All levels of students should be mixed up into even groups to represent even levels for each group. • Each group member needs to have a job within the group. • Each group needs be given a timeline of when the different parts of the project should be done In the Engineering Design Powerpoint, there is directions on how to make a solar oven out of postal/pizza boxes. This is a quick and easy introduction to this process. It gets the students involved in the project. The powerpoint will be in the teacher resource folder. If you decide not to do the project just make those slides null or delete the slides.

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Alternative Assessments	This section contains alternative assessments designed for special audiences, such as students with learning disabilities or English language learners. • If you provided modifications above, provide an alternative assessment for each modification or special audience. • If you did not provide modifications above, make sure to include the intended audience for the alternative assessment.
References	• https://www.rit.edu/kgcoe/sites/rit.edu.kgcoe/files/docs/Solar%20Energy%20Lesson%20Plan.pdf • http://skillpointalliance.org/wp-content/uploads/2013/09/Chapter-3-Teacher-Lesson-Plan.pdf • http://www.arborsci.com/cool/liquid_crystal_demos • http://tryengineering.org/lessons/nanohand.pdf • http://www.readworks.org/rw/k-12-paired-texts-question-sets • http://www.educationworld.com/a_lesson/lesson225.shtml
Supplemental Information	See Student and teacher folder for specifics on assignments. Web addresses for the Teacher & Students folders are below: Teacher: Student:
Comments	This lesson is part of a unit plan for solar energy to tie into a Renewable Energy Unit plan. It has the capability to be differentiated for grades 3- 10.