CAN A HYBRID POWER GRID BE USED DURING A NATURAL DISASTER?

RESET AN AEOP EFFORT aeop

TEACHER

Joyce Williams

Nancy Francis

SUBJECT/GRADE LEVEL

Subject

Chemistry

10-12

Physical Science

9-12

General Science

6-8

Materials

- KidWind Solar Energy Exploration Kit.
- Promethean Board
- Textbook
- Clay, plastic shapes and wire
- Art paper, color pencils, pens and markers
- Copies of activities instructions
- Computer, Google Classroom, Zoom, camera

STANDARDS

Next Generation Science Standards

- Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. HS-PS3-3
- Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-1
- Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. MS-ESS3-2

Mathematics Standards | Common Core State Standards

- Use probability to evaluate outcomes of decisions
  CCSS.MATH.CONTENT.HSS.MD.B.5

English Language Arts Standards | Common Core State

- CCSS.ELA-LITERACY.SL.11-12.1.A: Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually.

LESSON OBJECTIVE(S)

Students research and present information related to a hybrid power grid and produce a model of their idea of a hybrid power grid that can be used after a natural disaster has occurred.

Extension:

Students will understand why solar power cannot provide electricity if the power grid is down unless there is a storage source or the solar power is off-grid.

CAREER CONNECTION(S)

Mentor Background: Dr. Jonathan Boltersdorf is a research and development chemist at the U.S. Army Research Laboratory (ARL) in Adelphi, MD. Dr. Boltersdorf received a B.S. degree in chemistry from James Madison University in 2011. In 2016, he received a Ph.D. in chemistry from North Carolina State University in the area of solid-state photochemistry under the direction of Professor Paul Maggard. His doctoral research focused on utilizing solid-state and molten salt methods to synthesize new metal oxide semiconductor photocatalysts for solar energy driven total water splitting. From 2016-2018, he was a postdoctoral researcher under the direction of Dr. Jeffrey Read in the Advanced Battery Chemistry Team of the Electrochemistry Branch of ARL, where he worked on the assembly, electrolyte formulation, and electrochemical testing of hybrid lithium-ion battery-capacitors. Simultaneously, he worked with Dr. Kyle Grew and the Photoelectrochemistry Team on the synthesis and characterization of nanomaterials exhibiting surface plasmon resonances for studying photocatalytic reactions. In 2018, he became an Army Civilian and has continued his work with the Electrochemical Energy Conversion Team at ARL on novel alternative energy materials for chemical conversion and energy harvesting applications for the Army.

STEM Careers: meteorologist chemist electrical engineer environmental engineer disaster relief

ENGAGEMENT

Classroom	Virtual
Teacher Actions: 1. The teacher will present a video showing a natural disaster occurring and will ask students how people were impacted due to that disaster. 2. The teacher will have students brainstorm how humans have been impacted due to that natural disaster. 3. The teacher will ask students to come up with ideas for what can be done to mitigate the effects of the natural disaster. 4. The teacher will pose the question orally or on the Promethean: What is a solar cell and how does it work? What is meant by a hybrid energy grid? **Student Actions:** 1. Students will write the answer in their notebooks. They will formulate a list within their groups and add to a class list. 2. The students will hand write a response to the question, (one paragraph) response. The student may speak from their prior knowledge or do light research (use the textbook) to construct the response.	**Teacher Actions:** 1. A video showing a natural disaster occurring will be put on Google Classroom with a question about how people were impacted due to that disaster. 2. The teacher will pose a question on GC which will ask students to brainstorm ideas for what can be done to mitigate the effects of the natural disaster. 3. The teacher will pose the questions as a google classroom question : What is a solar cell and how does it work? **Student Actions:** 1. Students will respond on Google Classroom about how people were impacted as well as what could be done to mitigate the effects of the natural disaster. 2. The students will construct a response to the question using Google Doc and post it to the assignment thread in their Google Classroom, (one paragraph) . The student may speak from their prior knowledge or do light research (use the textbook) to construct the response.

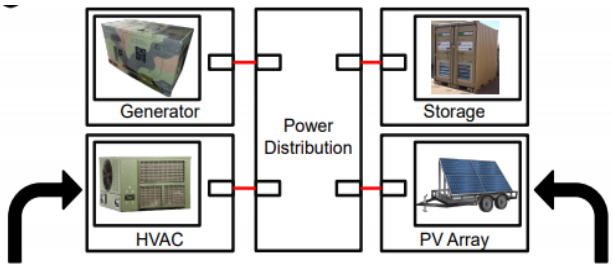
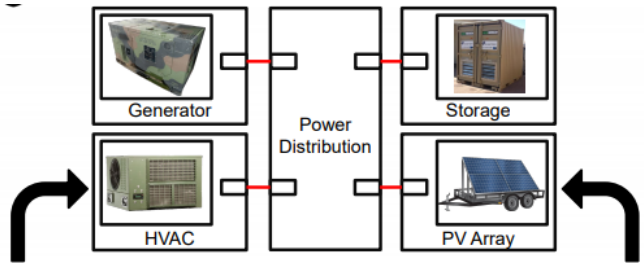
EXPLORATION

Classroom	Virtual
Teacher Actions: The teacher will assign students to groups using random selection such as SAMS or cards. The teacher will assign students the task of researching the topics: • What is solar energy? • How is it collected? • How can it be stored? • What can it be used to do? • How can it be used with other energies or be converted to other energies? The students will also research local natural disasters, disaster responses and energy solutions. **Student Actions:** The students may assign specific tasks to group members. The students will then research the various topics related to the production and use of solar energy cells. The students may start with a broad subject research using encyclopedias, books or magazine articles. The students may continue research using videos related to energy, solar energy, chemical energy and batteries through videos and articles. The students should then meet to crowdsource and brainstorm and edit collected research. The students will conduct several experiments using several lab exercises related to solar cells • Color of cells and length of tubing • Solar scavenger hunt • Solar Town • Nova Renewable Energy virtual lab • Glencoe Alternative Energy Sources LAB REPORT	**Teacher Actions:** The teacher will assign students to groups using random selection such as SAMS or cards. The teacher will assign students the task of researching the topics: • What is solar energy? • How is it collected? • How can it be stored? • What can it be used to do? • How can it be used with other energies or be converted to other energies? The students will also research local natural disasters, disaster responses and energy solutions. The groups will be given meeting rooms through Microsoft Teams to meet with their group members as well as share emails and phone numbers if comfortable with the idea. **Student Actions:** The students may assign specific tasks to group members. The students will then research the various topics related to the production and use of solar energy cells. The students may start with a broad subject research using google bing or another search engine, online books or magazine articles from sources such as Newsela, Smithsonian Tween Tribune and Magnolia. The students may continue research using YouTube videos related to energy, solar energy, chemical energy and batteries through videos and articles. The students should then meet in Schoology Online Discussion using, Shared Google Slide Deck to crowdsource and brainstorm and edit collected research. The students will conduct several experiments using several lab exercises related to solar cells • Energy • Solar scavenger hunt • Solar Town • Nova Renewable Energy virtual lab LAB REPORT

EXPLANATION

Classroom	Virtual
Teacher Actions: The teacher will reassemble the whole group. The teacher will facilitate a discussion regarding the findings from Exploration findings (labs and research). The class may ask questions and insert observations and comments. The teacher will model and explain the options that the groups may use to share the information they have gleaned. **Student Actions:** Each group should report out. The groups may use PowerPoint, google slides, a newsletter, a brochure or any prop used to illustrate the acquired knowledge. Rubrics: • PowerPoint • Newsletter • brochure	**Teacher Actions:** The teacher will reassemble the whole group. The teacher will use zoom or google hangout to video conference with class. The teacher will facilitate a discussion regarding the findings from Exploration findings (labs and research). The class may ask questions and insert observations and comments. The teacher will model and explain the options that the groups may use to share the information they have gleaned. **Student Actions:** Each group should report out. The groups may use PowerPoint, google slides, a newsletter, a brochure or any prop used to illustrate the acquired knowledge. The students may communicate knowledge through zoom, a video made through screencastify or YouTube or the students may make a Gif to personify their knowledge. Rubrics: • PowerPoint • Newsletter • brochure

ELABORATION

Classroom	Virtual
Teacher Actions: The teacher will assign scenarios to groups of students in which they will be a part of a disaster preparedness team. The goals will include providing the town with an electrical energy source, using solar power, in the event that a natural disaster occurs. Each team will need to determine the placement of solar panels in order to benefit the town the most while also protecting it from disaster. Assign different town settings: Rural, Urban, Mountainous/hills, Shoreline, Valley The class will discuss, illustrate and elaborate on the connection between solar energy cells, energy storage and how they are related and can be used in the event of a natural disaster. **Student Actions:** Each group will create a model of a hybrid power grid that they think can be used in the event of a major loss of power such as with a natural disaster. They will need to determine where to place the grid for the maximum benefit as well as to protect it from natural disasters. • A drawing • A 3D model using clay or plastic objects • A model using materials found in an electronic store augmented with material from the KidWind kit. 	**Teacher Actions:** The teacher will assign scenarios to groups of students in which they will be a part of a disaster preparedness team. The goals will include providing the town with an electrical energy source, using solar power, in the event that a natural disaster occurs. Each team will need to determine the placement of solar panels in order to benefit the town the most while also protecting it from disaster. Assign different town settings: Rural, Urban, Mountainous/hills, Shoreline, Valley On Zoom or google hangout the class will discuss, illustrate and elaborate on the connection between solar energy cells, energy storage and how they are related and can be used in the event of a natural disaster. **Student Actions:** Each group will create a model of a hybrid power grid that they think can be used in the event of a major loss of power such as with a natural disaster. They will need to determine where to place the grid for the maximum benefit as well as to protect it from natural disasters. • A drawing • A 3D model using clay or plastic objects The model or a snapshot of the model should be posted on the assignment thread in the Google Classroom. 

EVALUATION

Classroom	Virtual
Teacher Actions: Ask the following questions: • What is a solar cell? • How can it be used with other energy sources? How is it connected to energy storage? • How can it be used in a hybrid power grid, in the event of an emergency? Create a Google quiz using the questions above. Administer a written quiz **Student Actions:** • Will submit the PowerPoint, Google slides, newsletter, brochure or illustration. • Will submit laboratory reports for all laboratory exercises • Will submit the group model of a hybrid power grid, with a diagram showing where it will be placed and how it works. • Will respond to the above questions orally or as a written response • Will complete the google quiz • Will complete the written quiz	**Teacher Actions:** Ask the following questions using zoom or Google Hangout, • What is a solar cell? • How can it be used with other energy sources? How is it connected to energy storage? • How can it be used in a hybrid power grid, in the event of an emergency? **Student Actions:** • Will submit the PowerPoint, Google slides, newsletter, brochure or illustration. • Will submit laboratory reports for all laboratory exercises by scan or snapshot • Will submit the group model of a hybrid power grid. By illustration or snapshot • Will respond to the above questions orally or as a written response, using Google docs. • Will complete the google quiz from the Google Classroom. • Will complete the written quiz from the Google Classroom All evaluations will be posted to the Google Classroom thread using the hybrid power grid assignment thread.

REFERENCES

- https://www.vernier.com/search/?q=KidWind+solar+energy+exploration+Kit
- https://www.ametsoc.org/
- https://www.pbs.org/wgbh/nova/labs/lab/energy/
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