the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

Do you have a bright idea?

Grade Level	5	**Subject**	Light and Heat Energy Efficiency

Objective(s):
TSW show how his house/school can use sunlight energy more efficiently and to his advantage for heating, cooling, and lighting purposes.

SOL Addressed:
5.1 TSW demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations.

5.3 TSW investigate and understand basic characteristics of visible light and how it behaves.

5.7g TSW investigate and understand how Earth's surface is constantly changing. Key concept includes human impact.

Next Generation Science Standards:
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

3-5.Engineering Design
3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

<table>
<tr><td>Materials Needed Per Class of 30

and

Prior Knowledge</td><td colspan="2">Single pane, Double pane, and Triple pane window OR Glass Sample Set*
Thermometers (7)
Goose neck lamp with high watt bulb (7)
Light meter (7)
Mirrors (7)
Shoeboxes or tissue boxes (7)
Large pieces of cardboard
White and black paint
Construction paper in light and dark colors
Tape, glue, scissors
Paint brushes
Access to CEED dashboard
Brochures on each window type or internet access for research.

*Single pane and double pane windows can be obtained from a local contractor that does remodeling. These windows are discarded. Glass Sample Sets (GS1333) can be purchased from www.EDTM.com for $80.00.

Materials listed are for a class of 30 working in groups of 4-5.

<u>Prior Knowledge</u>:
Introduction to CEED dashboard.
Review of seasons in relation to location of sun and length of daylight.
Lesson on properties of light.
Demonstration of how to use a light meter using the lamps and windows.</td></tr>
<tr><td>Ways to differentiate this lesson plan</td><td colspan="2">• EXTENSION for Higher Level Learner
TSW design his own “home” using a shoebox/tissue box to use sunlight energy as efficiently as possible.
• MODIFICATIONS
TSW decide what type of window is most energy efficient and explain why.</td></tr>
<tr><td>Introduction/ Anticipatory Set</td><td>Anticipatory Set: Where does all energy come from?

Questions to ask students:
• How do you get your energy?
• How do animals get their energy?
• How do plants get their energy?</td><td>Introduction:
Today we will begin studying how sunlight energy can be used directly and indirectly for heating and lighting. You will need to remember properties of light and think about how those properties may help you.</td></tr>
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Guided Practice	TTW introduce the student to the CEED dashboard. • TTW show students how to get to the dashboard. • TTW show the student how to navigate the dashboard—solar, wind, HVAC, water, weather, extras. **Facilitator Questions for the Activity:** What do you discover when you select "more pictures" versus "more numbers"? What type of graph(s) was used to chart the data? What is the relationship between time of day and energy collected? Why do you think a line graph is used instead of a bar graph? What is the importance of collecting this data and graphing it?
Independent Practice	**Part 1** TSW use the CEED site to complete the worksheet at the end of this lesson. **Part 2** TTW present the students with the BIG QUESTION and the students will work as a team to come up a solution. BIG QUESTION: How can you use sunlight energy more efficiently and to your advantage for heating, cooling, and lighting purposes at home and at school? ***The teacher may need to offer some guidance to students in the inquiry process.*** 1. Identify the problem. 2. Research using the CEED site. "How We Did It" and "How It Works" tabs 3. Investigate with materials provided. 4. Analyze your findings. 5. Share your findings. ***Questions to ask students that need a little direction:*** How is the school/classroom heated and cooled? What type of window is used at school/home? How is the CEED building heated and cooled? Compare and contrast the CEED building to our school/home. Which window is most energy efficient and why? Why is one window more efficient than another? What could you do as the sun moves throughout the day? What changes can you make at school or home to improve efficiency?

Closure (Summary of Lesson)	TSW present their team findings to the class. Classmates will discuss what they discovered.
CEED Building Application/ Sensor Data	TSW access the dashboard and analyze solar data collected in relation to weather and time of day.
Assessment	Part 1: TSW be assessed on his worksheet responses and graph. Part 2: TSW be assessed informally and formally using the rubric at the end of this lesson.

INQUIRY LEARNING RESEARCH PROCESS GUIDELINES

The following table is just one guideline to use for developing your own inquiry materials. The seven steps in the Learning Research Process include not only how people learn but also how research is conducted. The heart of the design, the three-stage learning cycle of exploration, concept invention or formation, and application is embedded in the middle. In addition to these three stages, this design takes into account that learners need to be motivated to spend the time required for understanding complex subjects and that learners need to build this new knowledge onto prior knowledge. These are similar to the 5E and 7E learning models.

The Learning-Research Process

Steps in the Learning-Research Process	7E Equivalent	Component of the Activity
1. Identify a need to learn.	Engage	An issue that excites and interests is presented. An answer to the question *Why?* is given. Learning objectives and success criteria are defined.
2. Connect to prior understandings.	Elicit	A question or issue is raised, and student explanations or predictions are sought. Prerequisite material and understanding is identified.
3. Explore	Explore	A model or task is provided, and resource material is identified. Students explore the model or task in response to critical-thinking questions.
4. Concept invention, introduction, and formation	Explain	Critical-thinking questions lead to the identification of concepts, and understanding is developed.
5. Practice applying knowledge.		Skill exercises involved straightforward application of the knowledge.
6. Apply knowledge in new contexts.	Elaborate and Extend	Problems and extended problems require synthesis and transference of concepts.
7. Reflect on the process	Evaluate	Problem solutions and answers to questions are validated and integrated with concepts. Learning and performance are assess

Hanson, D. (2006). POGIL Instructor's Guide to Process-Oriented Guided-Inquiry Learning. Lisle, IL: Pacific Crest

CEED Data Collection

NAME: _____

Your birthdate: _____

What was the weather like on your last birthday?

How much solar energy was produced on your last birthday?

How much energy was used on your birthday?

Was more solar energy produced or used on your birthday? Explain why there was a difference and what you think accounts for the difference?

Record the class data on your chart. Then graph the data using a line graph using Excel, another program, or graph paper.

What can you infer about time of year and energy produced?

Class Data for Solar Energy Produced and Energy Used by Birthday

Date	Energy produced	Energy Used

NAME _____

Inquiry Scoring Rubric
Grades 3-5

	1. Beginning	2. Progressing	3. Proficient	4. Exemplary
Asks a testable question that may be explored through scientific investigation	Uses teacher-generated question	Asks testable question with considerable teacher guidance	Asks testable question with minimal teacher guidance	Asks testable question without teacher guidance that may be explored scientifically
Plans and conducts an investigation	Uses teacher-provided investigation	Plans and conducts an investigation with considerable teacher guidance	Plans and conducts a replicable investigation with few logic errors; may make changes which are not logical to the investigation	Plans and conducts a replicable investigation that has logical steps; may make logical amendments to the investigation
Uses a simple experiment and tools to gather data and extend senses	Does not choose appropriate tools/equipment and does not use them correctly and accurately	Sometimes chooses appropriate tools/equipment and sometimes uses them correctly and accurately	Usually chooses appropriate tools/equipment and usually uses them correctly and accurately	Consistently chooses appropriate tools/equipment and consistently uses them correctly and accurately
Uses data to develop a reasonable explanation to answer the question	Record of and organization of data is missing and explanation, if present, is illogical	Records of and organization of data is incomplete/ inaccurate and explanation may be logical but reflects incomplete/inaccurate data or scientific information	Usually records and organizes data in a logical manner and develops a reasonable explanation based on collected data and/or facts from reliable scientific sources	Consistently records and organizes data in a logical manner and develops a reasonable explanation based on collected data and/or facts from reliable scientific sources
Communicates procedures, results, and explanations of the investigation	Writes inaccurate instructions; does not use sketches; communicates incomplete and inaccurate descriptions of objects and events	Writes incomplete instructions; draws inaccurate sketches; ignores data when describing objects and events	Writes instructions that others can follow in carrying out procedures; makes sketches to aid in explaining procedures or ideas; uses qualitative data to describe and compare objects and events	Writes precise instructions that others can follow in carrying out procedures; makes detailed sketches to aid an explaining procedures or ideas; uses qualitative and quantitative data to describe and compare objects and events

Adapted from Nebraska Department of Education, http://www.education.ne.gov/science/Documents/InquiryRubric.pdf, 3/14/14