the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

Lighting a Light Bulb

Grade Level	4	**Subject**	Science

Objective(s):

- Demonstrate and illustrate how to light a light bulb using one and two wires.
- Compare and contrast types of solar panels for total collection of energy.

SOL Addressed: 4.3 b,d

- Understand the characteristics of electricity including basic circuits and the ability of electrical energy to be transformed into light and motion and to produce heat.

Materials Needed Per Class of 30

and

Prior Knowledge

light bulbs
wires (2 per pair of students)
D- cell batteries
switches

Prior knowledge:

- **A continuous flow of negative charges (electrons) creates an electrical current.**
- **The pathway taken by an electric current is a circuit.**
- **Closed circuits allow the movement of electrical energy.**
- **Open circuits prevent the movement of electrical energy.**
- **Among conducting materials, the rate at which energy flows depends on the material's resistance.**

Ways to differentiate this lesson plan

- **EXTENSION** for Higher Level Learner: After students can accomplish both tasks of lighting a light bulb with one and two wires. Pose question: 1.) Is there a way you can make the light bulb burn brighter? How? 2.) Can you incorporate a switch so that the light bulb only turns on when you close the switch? How would it need to be hooked up?

- **MODIFICATIONS** When it comes time to draw how you lit the light bulb, have a drawing already completed (consisting of the light bulb and battery) and students only draw lines (wires) to the proper placement on battery and light bulb.

Introduction/ Anticipatory Set

Anticipatory Set: How does a light switch work? Why does a light switch only turn on a few lights in your house and not all of the lights in the whole house?

Introduction: Today, we're going to be investigating how to light a light bulb. We will also discuss how the light bulb lights. As we work, I want you to be thinking about the questions asked earlier (anticipatory set) and see if you have an idea to the answers of them.

Guided Practice	• Each pair of students gets materials: one battery, two wires, one light bulb. • Discuss briefly expectations of behavior. • Allow students to discover on their own without further instructions. **Sample Facilitator Questions for the Activity:** • Once they get it to light with two wires: 1.) Draw in notebook. 2.) Did you try other ways that did not get the light bulb to light? Why do you think it wouldn't light those ways, but it did this way? May discuss quietly in groups and written in notebooks. To be discussed as a class later. • Second task it to have students light the light bulb using only one wire. Again, discuss failed attempts and why it lit only in a certain way. Draw in notebooks.
Closure (Summary of Lesson)	• Bring students together. Discuss failed attempts and why students thought they failed. How did you have to set up the wires so the light bulb lit? Why do you think it worked this way but not the other ways? • Continue discussion for using only one wire. Why did it work this way, but not the other ways? • Students draw light bulb in notebooks, label parts including filament, positive, and negative ends of light bulb. Explain that the flow of energy went in through the positive of the light bulb, flowed through the filament (which got very hot resulting in light), then flowed back out the negative insulated end of the light bulb and to the negative end of the battery. • In order for a light bulb to light, it need 2 things; a path for the energy to flow and a power source of energy. Which are the paths for the energy to flow in our experiment? *Wires* Which is the source? *Battery.* Do we have giant batteries in our homes? No, so where does our source of energy come from? *Substations, which flow to telephone poles, which come into our houses through junction boxes and control panels.*
CEED Building Application/ Sensor Data	How much energy does it take to light an average sized light bulb? *About 60-100 watts.* Go to Ceed dashboard: Click on Tracking PV Solar Collector. • How many watts is it currently collecting? • How many light bulbs would it be able to light if this was the only source of energy in the building? • Explore individual solar collectors; which is producing the most energy? Why do you think that is?
Assessment	Later in the unit, students will be formally graded in an end of the unit test. Students are also graded on quizzes pertaining to information discussed in 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	Elaborate and Extend	Problems and extended problems require synthesis

new contexts.		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