



the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

Transformation of Energy and Electricity Investigation			
Grade Level	4th	Subject	Natural Resources/Electricity
<p>Objective(s): The student will investigate the transformation of energy (solar, wind, chemical, mechanical) into electricity. The student will gather data from the CEED Dashboard and graph the amount of solar and wind energy produced during a one week period. The student will conduct an experiment to demonstrate the transformation of electricity into light, sound, and motion.</p>		<p>SOL Addressed: Science 4.1i-The student will demonstrate an understanding of scientific reasoning , logic, and the nature of science by planning and conducting investigations in which data are recorded, analyzed, and displayed using bar and basic line graphs.</p> <p>Science 4.3d-The student will investigate and understand the characteristics of electricity: the ability of electrical energy to be transformed into light and motion, and to produce heat.</p> <p>Science 4.9c-The student will investigate and understand important Virginia natural resources: minerals, rocks, ores, and energy sources.</p>	
		<p>Common Core 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.</p> <p>PS3.B: Conservation of Energy and Energy Transfer</p> <p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <p>W4.2-Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</p> <p>W4.7-Conduct short research projects that build knowledge through investigation of a topic.</p>	
<p>Materials Needed Per Class of 30 and Prior Knowledge</p>	<p>Materials Needed:</p> <ul style="list-style-type: none"> • 2 Energy Conversion Kits (SB45829M) (The item above can be ordered from eNasco.com and will be used in stations that students will rotate through) • teacher-created electric circuit kits for 10 groups of 3 students each: D cell battery, battery holder, set of three alligator connector cords, miniature bulb holder, miniature lamp, electrical buzzer, and 1" Diameter DC motor (The items in the kit can also be purchased at eNasco.com) • graph paper • science journals <p>Prior Knowledge:</p> <ul style="list-style-type: none"> • Students will have already covered Virginia's natural resources. This will serve as a review of that information. • Students will have already prepared simple circuits in earlier investigations. 		
<p>Ways to differentiate this lesson plan</p>	<ul style="list-style-type: none"> • EXTENSION for Higher Level Learner <ol style="list-style-type: none"> 1. Students will use the internet to research the types of energy that are used to create electricity for our area and create an Activboard flipchart to share with the class. 2. Students will monitor weather conditions (using the CEED Weatherbug site) and the energy generated by the solar collectors and wind generators (using the CEED Dashboard). They will use the information to determine how weather affects the amount of energy that is being generated and prepare a brief report to present to the class. • MODIFICATIONS Students will work in heterogeneous groups to complete activities. Students with Individualized Education Plans will be provided with additional assistance as needed. 		

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Instructional Activities

Introduction/ Anticipatory Set	<p>Anticipatory Set: Review the types of renewable and nonrenewable energy resources available in Virginia.</p> <p>Questions to ask students:</p> <ul style="list-style-type: none"> • What are some uses for the renewable and nonrenewable energy resources? • Which resource is used most often to create electricity? • Would any of the other energy resources be better for the environment? Explain your answer. 	<p>Introduction:</p> <ul style="list-style-type: none"> • Students will be divided into groups of three. Using the Activboard, the class will look at the data displayed on the CEED Dashboard. Each group will be assigned one of the solar collectors or wind generators to monitor during the week. Students will be asked to record the amount of energy that is being generated in their science journals. This information will be graphed at the end of the week and shared with the group. • The class will discuss how energy is being transformed from solar and wind to electricity that is being used to operate the electrical systems in the CEED building. Students will discuss how this compares to the electricity being used to operate systems in our building.
Guided Practice	<ul style="list-style-type: none"> • Each student group will be assigned to a station to investigate how electricity is generated by a solar cell (light), windmill (wind), hand generator (mechanical), and chemical (batteries) using items from the Energy Conversion Kit. Students will rotate through each station and record their observations in their science journals. • Ask students what happened to the energy that was generated by each device. Have students share their observations with the class. Write the observations on the Activboard. Discuss any variations that were observed. 	
Independent Practice	<ul style="list-style-type: none"> • Ask students what happens when electricity is used? Write responses on the Activboard. • Provide each group with an electric circuit kit. Ask students to create an electric circuit and use their circuit to demonstrate how electricity is transformed into other types of energy. Students will write their observations in their science journals. • The teacher will monitor the groups and question students about their observations. Students should be able to explain that the energy is being transformed from one type to another. 	

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Instructional Activities

Closure (Summary of Lesson)	Ask the following questions: <ul style="list-style-type: none">• What happened in the first activity when you worked with the hand generator, battery, windmill, and solar cell?• What was each type of energy transformed into?• How was electricity transformed in your second activity?• Can you create or destroy energy? What happens when energy is used?• What can we do to improve our environment using the natural resources available in our state?
CEED Building Application/ Sensor Data	Students will use data from the CEED Dashboard on a daily basis for a week to record the amount of electrical energy being produced by the solar collectors and wind generators. Students will graph their results and results will be shared. Students will be asked to decide which type of device would be best to use to gather energy to produce electricity for our building if we were to begin using renewable resources to generate our electricity.
Assessment	<ul style="list-style-type: none">• Students will be asked to use the information they recorded in their science journals to write a paper about the activities done during the lesson.• Student groups will prepare graphs of the data that was gathered from the CEED Dashboard.• Students will be asked to list electrical devices they use and tell how the electrical energy is transformed by the device.

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 <i>Why?</i> 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

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Instructional Activities

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