

Novel Classroom Experiment Demonstrating Photovoltaic Effect

Amal Kabalan, Villanova University, Villanova, PA 19085

Abstract

This paper introduces a novel classroom experiment demonstrating the photovoltaic effect. The student will be asked to show how a toy car can use a 50 mW solar panel to operate. First, the student will be instructed to assemble the car, second he or she will shine a flashlight on it. The student will notice that the car moved due to its exposure to light from the flashlight. Following the experiment the student is given a set of questions to answer which will lead him to the conclusion of the photovoltaics effect. This method of teaching will transform the student from a passive learner to an active learner. Instead of being taught “the definition of photovoltaics effect” the student will reach this knowledge on his/her own through active learning which is experimentation.

Introduction

Solar systems are considered a cornerstone in developing an energy usage scheme that does not depend on burning fossil fuels. People are being gradually exposed to the idea of solar energy systems through the media (TV commercials, newspapers advertisements etc...). Also the push for energy being provided from renewable energy systems has been on the rise.

A number of U.S. states require electricity providers to derive a minimum percentage of their power from renewable sources by a certain date. It is expected that in the future some states specify targets for particular forms of renewable power. Delaware, for instance requires that by 2019, 20 percent of the state’s electricity come from renewable resources. Of that 20 percent, the state mandates that at least 2 percent must come from solar technologies (1).

Since solar technologies are going to be more common in the next few years, it is imperative to introduce students in elementary schools to the idea of photovoltaic effect. For instance any elementary student knows that in order for a car to move, it must be fueled with gas. However, will he know that in the future we might have cars running on solar energy? Exposing elementary students to such ideas and concepts will integrate this knowledge in their realm of possibilities. It will also make them consider it as a possible goal to achieve.

The classroom experiment suggested in this paper will introduce the students to the concept of using solar energy to power cars. It will walk them through the experiment by first showing them that a small solar panel can make a toy car run.

Procedure

Copyright ASEE Middle Atlantic Regional Conference,
April 29-30, 2011, Farmingdale State College, SUNY

Before starting the experiment the student will be a given sheet that has the following questions:

Part I:

What do cars nowadays need to move?

A. Gas B. Wind C. Sun

What do cars emit when they move?

A. Water B. Sun C. Carbon dioxide

What could the effect of carbon dioxide on earth be? (2)

A. Global Warming B. Rain C. Candies

Part II:

After the student answers all these questions, the experimental procedure will be given to them. The procedure will be as follows:

- In the kit you will find plastic parts as shown in Figure 1.
- Use the manual to assemble the plastic parts into a car.
- Your car should look like Figure 2.
- After you are done, connect the solar panel to the car.
- Use the flashlight to shine light on the car.

What do you notice?

- Now use a sheet of paper and cover the flashlight with it while shining it on the car.

Did the car speed decrease or increase?

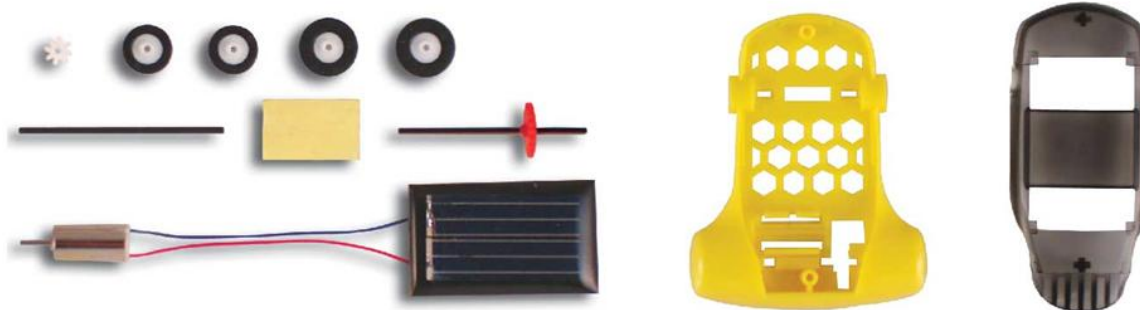


Figure 1: The parts of the experiment



Figure 2: The assembled car

Part III:

After the student completes the experiment successfully, he will be prompted to answer the following questions:

If the flashlight is the sun, can real cars move under the sunlight?

- A. Yes B. No

In this experiment, what did the sunlight substitute in the car?

- A. Wheels B. Windows C. Gas

If the car uses solar panel, does it emit carbon dioxide?

- A. Yes B. No

Which is better for the environment?

A. Cars that run on gas

B. Cars that run on solar energy

Why?

This will conclude the experiment section. The results will be used to analyze the student's understanding of the solar energy concept.

Results and Discussion

The first part of the experiment will be used to assess the student's prior knowledge of the form of energy used to move cars. It will also test if the student has an understanding of linking the production of carbon dioxide to global warming.

The assembling part of the experiment will enhance the student's recognition capabilities by letting the student to use his observation skills to read the manual and follow instructions to assemble different parts of the car into one unit.

The third part of the experiment will introduce the student to the concept of the photovoltaic which states the when light hits a solar panel, the solar panel will transform light energy into electrical energy and cause the car to move

The last section will be used to assess the understanding of the student to the concept. It will also lead the student to the conclusion that one possibility of reducing carbon dioxide is to use cars that run on solar energy.

Conclusion

The aim of this experiment is to introduce elementary students to the concept of photovoltaics using a real life example. It will also initiate the student into thinking about alternative forms of fuel, other than traditional gas, to fuel cars.

References

1. U.S. Department of Energy. [Online] May 2009.
http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm#map.
2. Williams, Laurence. *An End to Global Warming*. Kidlington, Oxford : Elsevier Science, 2002. pp.10-13.