Burglar Alarm: A Simple Circuit Hands-On Experiment

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Abstract

Hands-on activities are one of the most popular instructional tools that enhance student understandings of the science concepts and enable them to get involved in science practices as well. However, most of science educators underestimate its effectiveness in the classrooms. In order to illustrate how these activities could be utilized for science teachers, this study was constructed to present a sample hands-on activity for classroom purposes.
Keywords: Hands-on activities, science teachers, effective learning

Introduction

Recent researches (Beichner, 1994; Fischler and Lichtfeldt, 1992; Ireson, 1999; Zollman, 2001) pointed out upper secondary students with the most misconceptions among concepts of physics stem from electricity and magnetism concepts. Nevertheless, concepts of current, voltage, and electric field can be easily taught students via more concrete applications. Physics teacher still should focus on students' conceptual understanding of critical topics such as circuit and parts of electric circuit because it will be easier to let them construct their own concepts regarding main ideas of electricity and magnetism. As science teachers, we shouldn't use fast pace when we are detailing any concepts in Physics because it is very crucial that students sometimes are required more time to digest the concepts and create analytical thinking strategies essential in physics education.

At many public high schools, electric and magnetic concepts are introduced to the students in 8^{th} grade and are elaborated more in the following years until they graduate from high school. Therefore, our hands-on activity and applications of these concepts are designed for grade 8 and grade 9 level students. Our purpose at this activity is to introduce an application of electric concepts in an enjoying way of learning environment. It can be used for demonstrations in the classroom as well as applying it as a laboratory experiment.

We designed a simple burglar alarm circuit which can demonstrate how an electric circuit works and electric current is carried through electrical wires. Specifically, we aim to start "circuit breaker" concept in students, minds and utilize it while learning electric circuits and current.

Set-up

For this activity, necessary materials include:

- One speaker
- One battery (9-volt PP3 preferred)

- One sheet of aluminum foil
- Copper (conducting) wires
- Hard construction paper

Once all of the above materials are set, you can start building a house made of construction paper (20 cm * 20 cm * 20 cm). The house can be painted and door can be drawn on it to represent a real house structure.

Prior to setting up the circuit, some questions can be asked to the students such as "Why is aluminum foil used in the circuit?" and "Is there any other ways that we can set it up?" to attract students' attention to the presentation or experiment. They can brainstorm about questions raised and come up with ideas. Then, teacher can express and explain reasons regarding conductivity, current, and circuit materials. For example, he can define aluminum foil as 'it is a conducting material and can be easily deformed'. In addition, alternative conducting materials used can be named such as paper clip, or a piece of metal pen.

The home alarm circuit is designed to build up a circuit that goes through the paper house as shown in the figure 1.

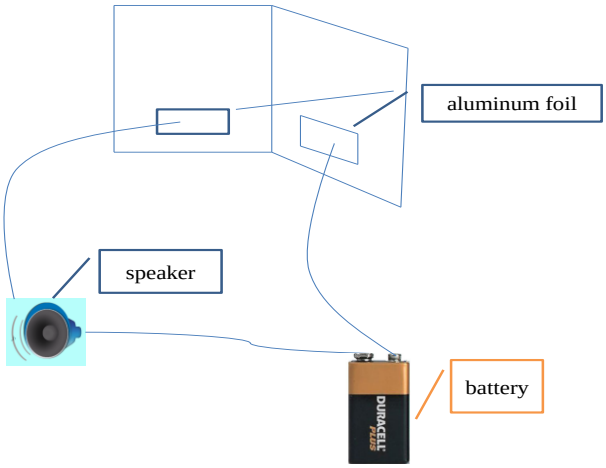

Figure 1. Visual display of the burglar alarm circuit.

Speaker is connected to any terminal of the battery and one side of the house with metal wire. Opposite terminal of the battery is connected to other side of the battery with conduction wire. The house will look like a two page book with the door open if you fold it up in half. Make sure aluminum foils do not touch each other when the door is closed. Otherwise, the circuit will be always open.

Followed by the construction of the burglar circuit, major concepts of electricity can be discussed and ask students follow up questions. Besides, a regular circuit can be showed (figure

2) to the students to clarify it more clearly since they are familiar with that type of drawing. It might help to visualize how a home electric circuit looks like in technical representation.

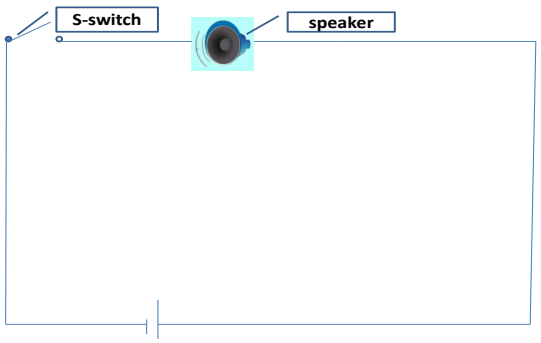

Figure 2. A standard circuit model

As a teacher, do not forget to mention what circuit breaker "s" represents (aluminum foil or other conducting material). When aluminum fails are contacted that means circuit breaker is closed so the current flows through the circuit.

In conclusion, this activity can be utilized to teach the concepts of current, circuit, and circuit breaker as well as constructing them. Circuit breaker plays a crucial role here because current flows when it is closed and it doesn't when it is open. Be careful about pitfalls and misconceptions regarding current and circuit breaker because sometimes students think of circuit breaker as the source of current. You can mention when the circuit is closed all of the circuit members starts functioning except short circuit. Resistance and resistivity can also be discussed in this activity.

In addition, this activity can be designed to demonstrate voltage, and rate of electric current conductivity of various materials which can become a great science project for especially middle school students.

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