BUILDING A BURGLAR ALARM - GRADE 9 APPLIED SCIENCE

ANA PEREIRA NEVES (/USERS/ANA-PN)

In this lab, students will design a simple burglar alarm circuit that will demonstrate how an electric circuit works and how electric current flows through electrical wires.

Grade Level/Course Code: Grade 9, SNC1P

Strand and Unit: Physics: Electrical Applications

Inquiry Focus:

Current electricity, load, conductor, source, control, circuit, conductor, insulator.

Timeline:

Pre-Lab: 40 minutes

Lab: 75 minutes

Post-Lab: 40 minutes

Big Ideas:

- Static and current electricity have distinct properties that determine how they are used.

Overall Expectations:

E2. Investigate, through inquiry, the properties of static and current electricity and the cost of the consumption of electrical energy

E3. Demonstrate an understanding of the concepts and principles of static and current electricity

Specific Expectations:

E2.1 Use appropriate terminology related to static and current electricity, including, but not limited to: *ammeter, ampere, battery, conductivity, current, energy consumption, fuse, kilowatt hours, load, ohm, potential difference, resistance, switch, voltmeter,* and *volts*

E2.2 Use an inquiry process to determine and compare the conductivity of various materials (e.g. metals, plastic, glass, water)

E2.4 design, draw circuit diagrams of, and construct simple series and parallel circuits (e.g., circuits with: one light bulb; two light bulbs of the same brightness; one light bulb on and the other light bulb off)

E3.3 identify the components of a simple direct current (DC) electrical circuit (e.g., electrical source, electrical load, switch, fuse), and describe their functions

E3.5 explain the characteristics of electric current, potential difference, and resistance, in simple series and parallel circuits

Key Concepts:

- Electric circuits are made up of four basic parts: Source, Conductor, Load, and Control.
- Conductors allow electricity to flow through them while insulators do not.
- Metals are good conductors of electricity.
- In an electric circuit, electrons flow from the negative side of the battery to the positive side.
- A circuit is the path along which electrons move or flow.
- An electric current is the flow of electrons.

Prior Skill Sets:

Students need to be able to draw circuit diagrams as well as schematic circuit diagrams before conducting this lab as well as be familiar with the lab investigation process. Students also need to be able to make predictions, complete all hand-outs, and work collaboratively with group members to complete all key aspects of this lab.

Prior Knowledge:

Students need to know the four basic parts of an electric circuit and their functions. In addition, students need to have a good knowledge of the difference between conductors and insulators and be aware of several examples of each. The Pre-Lab hand-outs will help students review these concepts before they design their simple burglar alarm.

Materials and Equipment:

- 10 cm x 10 cm cardboard
- 3 cm x 3cm piece of thin cardboard
- Aluminum pie plate
- Buzzer
- 9V battery
- 7 cm piece of picture hanging wire
- Wood clothespin
- Thumb tack
- 3 paper clips
- 3 elastic bands
- Scissors
- Clear tape
- Electrical tape

Safety:

Students should wear rubber gloves and goggles throughout this investigation.

Instructional Planning and Delivery:

In this lab, students will be building a simple burglar alarm circuit. Before designing their alarm students will complete the pre-lab exercises to help them understand the concepts behind this lab.

Pre-Lab:

In pairs, students are to read the hand-out entitled *Pre-Lab: Current Electricity* and complete the following two worksheets: *Pre-Lab: Burglar Alarm Circuit* and *Pre-Lab: Conductors and Insulators*.

Once completed, the teacher will circulate to each group to verify and correct the worksheets.

Lab:

Students are to design their burglar alarm circuit. Students are to follow these steps to complete their circuit.

1. Place the 9V battery on the 10 cm x 10 cm cardboard on the upper right corner.

2. Poke two holes with a thumb tack on either side of the 9V battery and place battery aside.
3. Loop an elastic band through the two holes and secure it at the back with a paper clip.
4. Place the battery on cardboard again and secure it to the cardboard with the elastic.
5. Place the buzzer on the 10 cm x 10 cm cardboard on the upper left corner.
6. Poke two holes with a thumb tack on either side of the buzzer and place buzzer aside.
7. Loop an elastic band through the two holes and secure it at the back with a paper clip.
8. Place the buzzer on the 10 cm x 10 cm cardboard again and secure it to the cardboard with the elastic.
9. Place the clothespin in the middle of the 10 cm x 10 cm cardboard *(between the battery and buzzer*).
10. Poke two holes with a thumb tack on either side of the clothespin and place the clothespin aside.
11. Loop an elastic band through the two holes and secure it at the back with a paper clip.
12. Place the clothespin on the 10 cm x 10 cm cardboard again and secure it to the cardboard with the elastic.
13. Cut two 3 cm x 3 cm squares from the aluminum pie plate.
14. Poke one hole with the thumb tack on the right hand side of each aluminum square.
15. Tape the aluminum square cut-outs to the inside of the clothespin. One square on top and the other at the bottom.
    Tip: Ensure that the holes are facing outward and in opposite directions (one to the left and one to the right) and that the cut-outs are not touching the metal spring of the clothespin.
16. Cut out one 3 cm x 3 cm square from a thin piece of cardboard.
17. Poke a hole close to the edge of thin square of cardboard and tie a string through the hole.
18. Tie a thumb tack to the other end of the string.
    Tip: The 3 cm x 3 cm square of thin cardboard will be used as an insulator and when placed in between the two 3 cm x 3 cm squares of aluminum plate the circuit will not work. The switch will be open.
19. Using electrical tape, tape the red wire to the positive end of the battery.
    Tip: Ensure that metal wire inside the red plastic coating is making contact with the positive end of the battery.
20. Loop the black wire through the hole on the left side of the 3 cm x 3 cm aluminum square.
    Tip 1: ***Ensure that the metal wire inside the black plastic coating is touching the aluminum square.***

    Tip 2: Use a wire stripping knife to remove plastic coating from the ends of the wire.
21. Loop one end of the 7 cm picture hanging wire through the hole on the right side of the 3 cm x 3 cm aluminum square.
22. Using electrical tape, tape the other end of the 7 cm picture hanging wire to the negative end of the 9V battery.
    Tip: Ensure that metal wire is making contact with the negative end of the battery.

Student Support Resources:

Hand-outs (attached)

- Pre-lab: Current Electricity
- Pre-Lab: Burglar Alarm Circuit
- Pre-Lab: Conductors and Insulators
- Lab: Burglar Alarm Circuit
- Post-Lab: Burglar Alarm Circuit Questions
- Rubric: Burglar Alarm Circuit

Assessment Opportunities:

The Pre-Lab worksheets will be used as an assessment for learning strategy in this investigation and teacher descriptive feedback will be used as an assessment as learning strategy. Teachers will give descriptive feedback to students throughout this investigation. The rubric included with this resource will be used as a tool for assessment of learning in this lab.

Future Extensions:

As an extension to this lab, teachers can ask students to compare the conductivity of various materials by attaching them to the inside of the clothespin, including plastic, glass and water. Another extension can be to ask students to add other loads to their simple burglar alarm series circuit. They can add more loads to their series circuit and then they can add other loads in parallel. This would help students compare the characteristics of a series and parallel circuit.

WATCH THE VIDEO
00:26 min

(//www.youtube.com/embed/AbtAEEq4qHk?width=800&height=450&iframe=true)

RESOURCES

- Alarming Switches (https://www.youtube.com/watch)
- Pre lab: Current Electricity.pdf (https://connex.stao.ca/sites/default/files/pre-lab_-_current_electricity.pdf)
- Pre Lab: Burglar Alarm Circuit.pdf (https://connex.stao.ca/sites/default/files/pre-lab_-_burglar_alarm_circuit_0.pdf)
- Pre Lab: Conductors and Insulators.pdf (https://connex.stao.ca/sites/default/files/pre-lab_-_conductors_and_insulators_0.pdf)
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- Post Lab: Burglar Alarm Circuit Questions.pdf (https://connex.stao.ca/sites/default/files/post-lab_-_burglar_alarm_circuit_questions_0.pdf)
- Rubric: Burglar Alarm Circuit.pdf (https://connex.stao.ca/sites/default/files/rubric_-_burglar_alarm_circuit_0.pdf)

ELEMENT

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