90 Getting Wired

Purpose

To build a model that illustrates electric current.

Required Equipment/Supplies

4 D-cells (1.5 volt)
D-cell battery holder
3 alligator clip leads
2 bulbs and bulb holders

Discussion

While we can float on a raft gliding down the Mississippi or ride in cars moving in traffic, nobody can *see* electric current flow. Even in the case of lightning, we are seeing the flash of hot glowing gases produced by electric current—not the current itself. However, we can infer the presence of electric current using lightbulbs and magnetic compasses in much the same way as a flag indicates the presence of wind. In this activity, you will build a *model* to study electric current.

Activity

Part A: What Is Happening in the Wires?

Procedure

Step 1: With the circuit arranged as shown in Figure A, turn the bulbs on and off by connecting and disconnecting one of the wires.

Observe the wires when the circuit is closed.

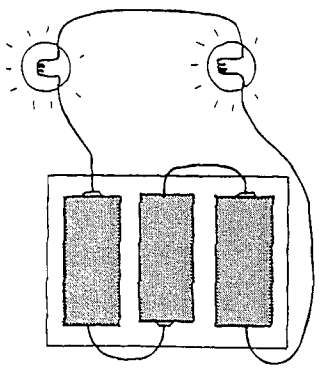

Fig. A

1. Is there any visual evidence that something is moving around the circuit when the bulbs are lit? For example, does one bulb light before the other? Does one bulb go out before the other? Is one bulb brighter than the other?

Position a compass underneath the wire.

Step 2: Place a magnetic compass on the table near the circuit with the needle pointing to the "N." With the bulbs unlit, place one of the wires on top of the compass parallel to the needle as in Figure B. Connect and disconnect a lead in the circuit several times while you observe the compass needle. Observe what happens to the needle when the bulb lights. Observe what happens to the needle when the bulbs go out.

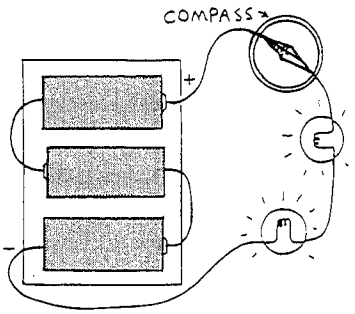

Fig. B

Step 3: Place the compass beneath the wire in different parts of the circuit. Be sure the needle is parallel to the wire when the bulbs are not lit. Observe the needle as you open and close the circuit several times. Look to see if the needle deflects in the same direction as before. Look to see if the amount of the needle's deflection is the same as before. Also, observe whether the bulbs must be lit to deflect the compass needle.

2. What evidence supports the notion that something is happening in the wires while the bulbs are energized?

3. What evidence supports the notion that whatever is happening occurs uniformly in all parts of the circuit?

Name Period Date

Part B: Is There Directionality to What Is Happening in the Circuit?

Step 4: Arrange the circuit as in Figure A. Place one of the wires on top of the compass parallel to the needle. Open and close the circuit while you carefully observe the needle. Note whether the needle deflects clockwise or counterclockwise.

Observe the deflection of the compass.

Step 5: Reverse the leads from the battery without altering the circuit and compass. Do this by simply exchanging the lead connected to the positive terminal of the battery with the lead connected to the negative terminal. Open and close the circuit while you watch the compass needle. Watch the needle deflect and note whether it is clockwise or counterclockwise.

Reverse the leads from the battery and observe the deflection of the compass.

4. Is the direction of the deflection the same as in Step 4, before the leads to the battery were reversed? Is the amount of the needle's deflection the same as before?

5. Suppose something is flowing in the wires. Do you think the *direction* the needle is deflected is caused by the amount of the flow or the direction of the flow?

Step 6: Remove one of the D-cells from the battery holder so that the battery holder only has two cells instead of three. Carefully observe deflection of the needle while you repeat Steps 4 and 5.

Remove one of the cells from the battery.

6. How do the size and direction of the compass needle's deflections compare when you use two cells instead of three?

Step 7: Install two more D-cells in the battery holder so that it has four D-cells. Carefully observe deflection of the needle as you repeat Steps 4 and 5.

Add two cells to the battery.

7. How do the deflections of the compass needle compare with those with two and three D-cells? Do you think the *size* of the needle's deflection is caused by *amount of the flow* or the *direction of the flow*?

Analysis

8. Hypothesize what is happening in the circuit when bulbs are lit.

9. Hypothesize what is happening in the circuit when the direction of the compass deflection reverses.

10. Hypothesize what is happening in the wires when the amount of the needle's deflection increases or decreases.

11. What do you think the battery does?