Charge in Motion

Trace cause and effect in electricity simulations

PHS.9.1 "Use digital resources and online simulations to investigate the basic principles of electricity, including static electricity, current electricity, and circuits. Use digital resources (e.g...."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each change the student makes in a simulation, then circle the result of that change. Number each matching change and result so you can trace what caused each observation.

Three Tests, One Big Idea

1. In a static-electricity simulation, a student drags two neutral balloons across a wool cloth. Electrons move from the cloth to each balloon, so both balloons become negatively charged and the cloth becomes positively charged. Next, the student brings the balloons close together without letting them touch. The balloons move apart because objects with like charges repel. Dragging the balloons transfers charge; bringing them close makes the repulsion visible. These two steps test different ideas, so the student records them separately rather than treating them as one change.

2. In a circuit simulation, the student connects a battery, a switch, and a bulb with wires to form a complete loop. Closing the switch gives charge a continuous conducting path, and the bulb lights. Opening the switch breaks that path, and the bulb goes dark. With the switch closed again, the student adds a second identical bulb in series, in the same loop. Both bulbs glow less brightly than the original single bulb because the added bulb increases the loop's total resistance and reduces the current. The battery setting stays the same, allowing a fair comparison.

3. A magnetic-field simulation adds a compass and a field meter beside a straight wire connected to a power source. When current flows, the compass needle turns because moving electric charges produce a magnetic field around the wire. The student holds the compass and meter in fixed positions and reverses the current. The compass needle turns the opposite way, showing that the field direction has reversed at that position. When the student raises the current without moving the meter, the meter reports a stronger field. A useful model must show both the current's direction and the field's response.

2 ANSWER WITH EVIDENCE

Use the passage

1. What happens to electrons when the student drags both balloons across the cloth? What separate action makes the balloons' repulsion visible?

2. In the circuit simulation, what changes when the student opens the switch, and why does the bulb go dark?

3. With the battery setting unchanged, how does adding a second bulb in series affect the bulbs? Explain using the passage.

4. At the compass's fixed position, what observation shows that reversing the current reverses the magnetic field's direction?

3 YOUR TURN

Your own words

Use an online magnetic-field simulation to make a two-panel model of current in a straight wire. Keep a compass at the same spot beside the wire, show current flowing in opposite directions in the two panels, label the magnetic field's direction at the compass in each, and write two sentences explaining how the simulation tests your model.

Charge in Motion

PART 1 · READ AND MARK

Underline each change the student makes in a simulation, then circle the result of that change. Number each matching change and result so you can trace what caused each observation. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What happens to electrons when the student drags both balloons across the cloth? What separate action makes the balloons' repulsion visible?	**Electrons move from the cloth to both balloons. Bringing the charged balloons close together makes their repulsion visible.**
2	In the circuit simulation, what changes when the student opens the switch, and why does the bulb go dark?	**Opening the switch breaks the continuous conducting path, so current stops flowing through the bulb.**
3	With the battery setting unchanged, how does adding a second bulb in series affect the bulbs? Explain using the passage.	**Both bulbs glow less brightly than the original single bulb because the added bulb increases total resistance and reduces current.**
4	At the compass's fixed position, what observation shows that reversing the current reverses the magnetic field's direction?	**The compass needle turns the opposite way when the current is reversed.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: The wire is vertical, current points up, and a compass sits to its right; the field at the compass points into the page. Panel 2: The wire and compass stay in place, current points down, and the field at the compass points out of the page. I would reverse the current in the simulation without moving the compass. If its needle turns the opposite way, that supports my model's prediction that the field direction reverses.

For question 1, require both steps: dragging transfers electrons, while bringing the charged balloons close reveals repulsion. In the model, accept any consistent wire and compass placement if reversing current also reverses the labeled field direction at that fixed position.