Fields in Motion

Use observations and comparisons to evaluate two linked investigations.

HS-PS2-5 "Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each sentence that describes an observation or result. Circle each comparison, repeated trial, or controlled condition that makes the evidence stronger.

Testing Invisible Effects

1. At a bench station, a team places a compass beside a straight insulated wire. The wire connects to a low-voltage DC power supply through a switch. With the switch open, students record the compass direction for ten seconds. Then they close the switch and record the needle's angle again. They repeat three trials at the same wire-to-compass distance. Next, they reverse the power supply connections and repeat the measurements. A steady current in the wire produces a magnetic field around the wire, so a consistent needle deflection is evidence of that field.

2. For a second investigation, the team connects a coil of insulated wire to a sensitive galvanometer. They hold a bar magnet still near the coil and record the meter reading. They move the magnet into the coil at a steady speed, then pull it out at the same speed. For each motion, they record the meter's direction and largest deflection. They repeat the trials with the same magnet, coil, and starting position. A changing magnetic field through the coil can induce an electric current. A meter deflection during motion, but not while the magnet is held still, supports this claim.

3. Good investigations use comparisons rather than a single observation. In the compass test, the switch-open condition is a baseline; closing the switch changes whether current flows. Reversing the connections changes the current's direction while the compass position stays fixed. In the coil test, a still magnet is a comparison for a moving magnet. Moving the magnet inward and outward changes the direction of the magnetic field's change. Record observations in a table, including trial number, condition, and meter or compass result. Evidence is stronger when repeated trials show the predicted pattern and only the planned variable changes.

2 ANSWER WITH EVIDENCE

Use the passage

1. What observation before and after closing the switch would provide evidence that the wire's current produces a magnetic field?

2. Name two parts of the compass investigation that improve its reliability or control variables.

3. Why is holding the magnet still near the coil an important comparison condition?

4. What information should the team include in its data table, and why do repeated trials make the evidence stronger?

3 YOUR TURN

Your own words

In 6 sentences, plan a two-part investigation using the provided wire, compass, power supply, switch, coil, bar magnet, and galvanometer. Include a comparison condition, what you will keep the same, repeated trials, and the evidence you would expect for each part. After teacher approval, actually conduct both investigations using the provided apparatus. Teacher checks the current-limited low-voltage circuit; open the switch between brief readings and before reversing connections. For each of three trials, record open-switch, closed-switch and reversed-current compass directions/angles at the same distance. For each of three coil trials, record still-magnet, inward-motion and outward-motion meter direction and maximum reading with its unit or scale division. Make two tables on separate paper; label all conditions, trial numbers and units. Write a separate conclusion for each claim using your observed comparisons. Include unclear or contrary results and a possible measurement limitation; do not fill the tables with predicted results.

ANSWER KEY

Fields in Motion

HIGH SCHOOL · HS-PS2-5

PART 1 · READ AND MARK

Underline each sentence that describes an observation or result. Circle each comparison, repeated trial, or controlled condition that makes the evidence stronger. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What observation before and after closing the switch would provide evidence that the wire's current produces a magnetic field?	**The compass needle stays in its original direction with the switch open and shows a consistent deflection when the switch is closed.**
2	Name two parts of the compass investigation that improve its reliability or control variables.	**The team repeats three trials and keeps the wire-to-compass distance the same.**
3	Why is holding the magnet still near the coil an important comparison condition?	**It tests the coil when the magnetic field is not changing. A lack of meter deflection then supports the conclusion that motion, or changing magnetic field, causes the induced current.**
4	What information should the team include in its data table, and why do repeated trials make the evidence stronger?	**The table should include trial number, condition, and the compass or meter result. Repeated trials showing the same predicted pattern make a random observation less likely.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I will place a compass a fixed distance from a straight wire connected to a low-voltage DC supply and switch. I will record the needle direction with the switch open, close it, and repeat three trials without changing the distance. A consistent deflection only when current flows will be evidence that current produces a magnetic field. I will connect a coil to a galvanometer and move the same bar magnet into the coil, then hold it still and pull it out at the same speed. I will repeat each motion three times while keeping the magnet, coil, and motion speed the same. Meter deflections during motion, with no deflection while the magnet is still, will be evidence that a changing magnetic field produces current. Completed-investigation check: require two actual three-trial tables with all six specified conditions represented, followed by two evidence-based conclusions. Consistent compass changes when current flows support current producing a magnetic field; meter deflections during magnet motion compared with rest support changing magnetic field producing current. A weak or absent reading calls for a connection, alignment or sensitivity check, not invented evidence.

Accept equivalent investigation plans that clearly test both phenomena with appropriate provided tools. A strong response identifies observable evidence, includes a comparison and repeated trials, and keeps relevant conditions constant. The six-sentence requirement applies to the original plan only. Also require actual conduct with the supplied tools, recorded readings and conclusions based on those readings. Teacher must provide a current-limited low-voltage setup and check connections. Do not connect a bare wire across an unrestricted power supply. Open the switch before changes; keep the magnet away from the compass test. Accept unexpected or unresolved results honestly and distinguish evidence from proof.