Current and magnetic field direction

Student activity • demonstration and reasoning

YEAR 11 / LESSON 81 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

What changes when the direction of current is reversed?

Observe a staff-operated insulated-wire and compass demonstration, then use labelled field models.

Equipment

- Staff insulated-wire and compass setup, isolated current-limited d.c. supply, ammeter, switch and limiter
- Booklet, pencil and field-model cards

Staff operate the circuit only. Keep conductors insulated and supported; switch off before changing connections. Limit each pulse to two seconds and stop if anything warms. No shorted cells, exposed mains, high-current coils or loose iron filings. Keep magnetic apparatus away from sensitive devices.

Course coverage: Shared Physics / Double Award: 6.8. Current produces a magnetic field. Physics-only extension: 6.9P–6.10P electromagnets and field patterns.

Plan, model or apparatus sketch

Draw labelled magnetic-field, current and force arrows where relevant.

Method and reasoning

Read the whole sequence before starting

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1. Staff place a straight section of insulated wire just above and parallel to a compass needle at rest. The wire is supported; keep the return lead well away from the compass.

2. Staff use an isolated low-voltage d.c. supply with an ammeter, switch and suitable current limiter. Start at zero; use at most 6 V and 0.5 A, or the lower equipment rating. Close the switch for no more than two seconds and observe the needle.

3. Open the switch and record the return direction. Reverse the connections with the power off, then repeat at the same current and wire position. Repeat the comparison once.

4. Draw the conventional current direction and circular field direction using the right-hand grip rule. Explain why the compass responds to the combined field of the wire and Earth.

5. Physics-only extension: draw a flat coil and solenoid, show their field patterns, and explain how an insulated coil around a soft iron core forms an electromagnet. Double Award alternative: annotate and compare the straight-wire observations.

6. Compare the models with the observed changes. Do not infer a numerical field strength from the compass angle without accounting for Earth’s field and the geometry.

Cleanup

- Open the switch, turn off the supply and return the compass and leads.

Record your evidence

Blank spaces are for your own work

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Reference and task data

The compass needle is not a current meter. Its deflection depends on the local total field. If the effect is too small, use an original labelled diagram or staff recording; do not exceed the current limit or remove the limiter.

Condition	Trial 1 direction	Trial 2 direction
Off		
Forward current		
Reversed current		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. What causes the field around the wire?

2. What happens when current reverses?

3. Why keep the return wire away?

4. What happens when the switch opens?

5. What does the right-hand thumb represent?

6. Extension: why use a soft iron core?