energy-forces

Magnets and magnetism

Lesson at a glance

Open by holding a magnet above a steel paperclip so it jumps, then above a plastic lid so nothing moves. Pupils learn magnetic vs non-magnetic, then groups test a tray of everyday objects and sort them on the Investigation Journal page. Drive the sorting-tree interactive on six unseen metals to break the "all metals stick" rule. Groups then run a fair paperclip-chain strength test on Magnets A and B, three trials each, taking the ordered middle value, and close with a display-only talk on what stayed the same.

Learning objectives

- Classify everyday materials as magnetic or non-magnetic from testing
- Compare magnet strength using a fair method and record the results

Before the bell — prep

Night before: one tray per group with two magnets that truly differ in pull (e.g. bar + weaker fridge magnet), sticky dots labelled A/B, ~20 steel paperclips, and mixed objects (steel clip, nail/screw, aluminium foil, plastic lid, wooden stick, rubber eraser, copper wire, card). Print Investigation Journal pages. Do not use euro coins as the non-magnetic metal — use copper wire.

Lesson 19

Materials

Item	Qty	Per	Source	Low-cost substitute
bar magnet or fridge magnet (pair expected to differ in strength)	2	group	school kit	one fridge magnet per group and compare through paper sheets instead of comparing two magnets (teacher directs the through-paper method)
sticky labels or coloured sticky dots (magnet labels A/B)	2	group	classroom	masking tape with A/B written in marker
steel paperclips	20	group	classroom	small steel screws or steel nails for the chain test
mixed test objects (steel nail or screw, aluminium foil square, plastic bottle lid, wooden lolly stick or pencil, rubber eraser, short copper wire, small piece of card)	1	group	classroom	any safe mix of steel items and clearly non-metal classroom objects, plus copper wire or a pure-copper offcut
plain paper sheets (for through-paper strength measure if only one magnet is available)	10	group	classroom	pages from scrap paper
Investigation Journal pages	1	pupil	provided printable	plain paper ruled into a two-group sort and a simple results table

Safety watch-point

Keep magnets away from phones, tablets, bank cards, IWB remotes and any adult with a pacemaker. Watch fingers if strong magnets snap together; count paperclips back off the floor.

Teaching moves

- **Getting Started:** Demo only: magnet above a steel paperclip, then the same magnet above a plastic lid. Ask "Why does the paperclip move when the plastic does not?" Keep trays off desks and do not name fair-test variables yet.
- **What magnets pull on:** Say the two short definitions in your own words — magnetic pulls toward the magnet; non-magnetic does not — then stop. Save magnet strength for step 5. Model one wonder–predict–test cycle aloud with aluminium foil before groups begin.
- **Test and sort the materials:** Hand out one magnet per group. Rule: bring the magnet close; do not scrape. Point them to the sorting rows on the Investigation Journal page as they go. Circulate asking "What did you observe? Was that what you predicted?" End with a 30-second room check (chair leg or whiteboard rubber).
- **Six metals, one surprise:** Open the sorting-tree interactive in explore mode and drive it yourself. Do not re-sort the tray — these six metals were not tested. Take a hands-up prediction before every reveal. Save the 1c coin for last; land "some metals, not all metals" plainly.
- **Fair-test magnet strength:** Point groups to labelled Magnet B. Agree fair-test rules together, then model one full paperclip chain at the front. Change the magnet; measure chain length; keep clips, pole and method the same. Three trials each; order the counts; take the middle value. Write a 5-8-6 → 5-6-8 example on the board so ordering is not optional. Time-tight path: two magnets, chain only, skip through-paper.
- **Record on your journal page:** Quick complete-and-check of records begun in steps 3 and 5 — not a fresh write-up. Numbers in the table; the "Magnet ___ is strongest because..." sentence after. If time is tight, prioritise one clear strength comparison over polishing every sort row.
- **Make sense of our results:** Collect a few group middle values on the board. Draw out: magnetic items were mainly iron/steel; strength claims need a fair method, repeats and an ordered middle value. If anyone still says all metals stick, hold foil and a paperclip up again.

What it should show

Magnetic pile: steel paperclip, iron nail/screw. Non-magnetic: aluminium foil, plastic lid, wood, rubber, copper wire, card. Euro 1c/2c/5c stick (copper-plated steel) — surprise, not a non-magnetic exemplar. Stronger magnet holds the longer paperclip chain (higher ordered middle value). Odd short chains usually mean clips were bumped or the pole/method changed between trials — re-run from a still start.

Lesson 19

Misconceptions & interventions

- **"All metals are magnetic" — pupils judge by shiny or metallic looks.** — Hold aluminium foil and copper wire beside a steel paperclip and retest live. Restate: iron and steel pull; aluminium and copper do not. Save the 1c coin as the coated-steel surprise.
- **"The bigger magnet is always stronger."** — Point to their ordered middle values: "Which number is higher?" Size can help, but material and type matter — that is why we measure with the same chain method.
- **Pupils take the middle trial as written (e.g. 8 from 5, 8, 6) instead of ordering first.** — Write 5, 8, 6 beside ordered 5, 6, 8 on the board. Say the rule every time: order smallest to largest, then take the middle number.

Differentiation

Emerging	Developing	Proficient
• Shorter sort set of about 6 clear items; teacher table models one full chain trial before the group continues Magnets A and B.	• Add a mystery object (stainless spoon or euro 1c) and justify the pile with evidence; finish three ordered trials for both magnets.	• Compare a third labelled magnet with the same chain rules, or critique another group's fairness: what changed, what stayed the same?

Cross-curricular hook

Tie to Maths Data — order three trial counts and take the middle value (median) before claiming which magnet is stronger.