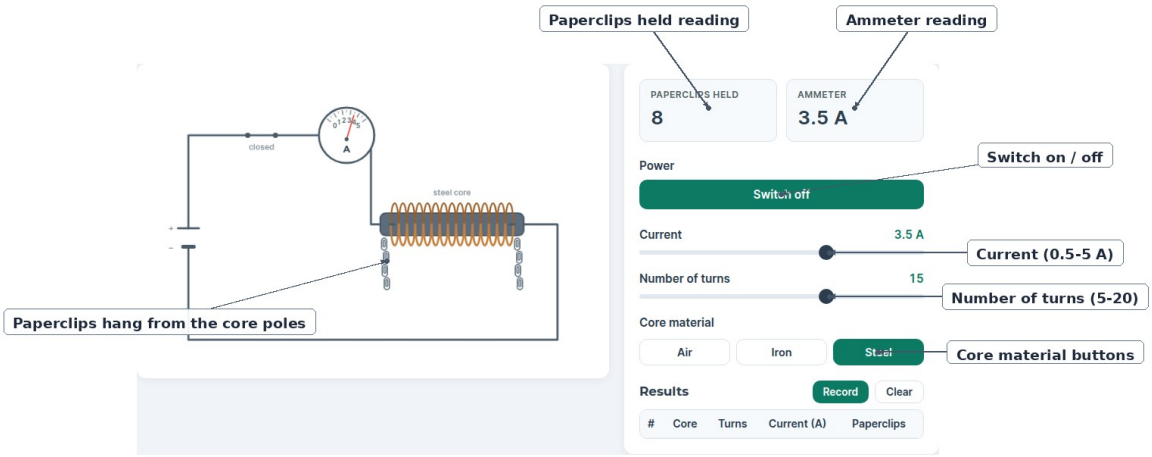
Investigating Electromagnet Strength

Current, Turns and Core Material

Aim:

You are investigating how current, the number of coil turns, and the core material affect the strength of an electromagnet, measured by how many paperclips it can hold.



Prediction:

You will compare an iron core and a steel core, using the same current and number of turns for both. Which do you predict will hold more paperclips while the current is switched on?

Test it in the simulation before you start your method.

Method:

1. Choose the **Iron** core, set **Current** to 1.0 A and **Number of turns** to 10, then press **Switch on**.
2. Press **Record** to log this reading in your results table.
3. Keeping the turns and core the same, increase the **Current** in 0.5 A steps. Press **Record** after each change.
4. Return the current to a fixed value, then change only the **Number of turns**. Press **Record** after each change, taking at least five readings.
5. Keeping current and turns fixed, compare the three core materials — **Air**, **Iron** and **Steel** — one at a time, pressing **Record** for each.
6. Only use **Clear** if you need to restart your table — otherwise keep every reading for the Analysis section.

Results:

#	Core	Turns	Current (A)	Paperclips

Analysis:

Using only your rows where turns and core were fixed, plot a graph of paperclips held (vertical axis) against current (horizontal axis) with the Graph Builder tool. What pattern do you see? What happens to the paperclip count when you double the current?

Using only your rows where current and core were fixed, what pattern do you see between the number of turns and the number of paperclips held?

Compare your three core-material readings, taken with the same current and turns. Which material held the most paperclips? Which held the fewest?

Explaining why:

Switch off while using the steel core, then switch off while using the iron core (same current and turns each time). What do you notice about the paperclips each core holds once the power is off?

Inside a magnetic material, tiny regions called **magnetic domains** can line up with an applied field. A material that keeps this alignment after the field is removed is said to have kept its **remanence**.

Use the idea of magnetic domains to explain why a steel core stays magnetised after the current stops, while an iron core loses its magnetism almost immediately.

A relay or an electric bell needs its electromagnet to switch on and off cleanly. Use your answers above to explain why iron, not steel, is the better core material for this job.