ACTIVITY SHEET

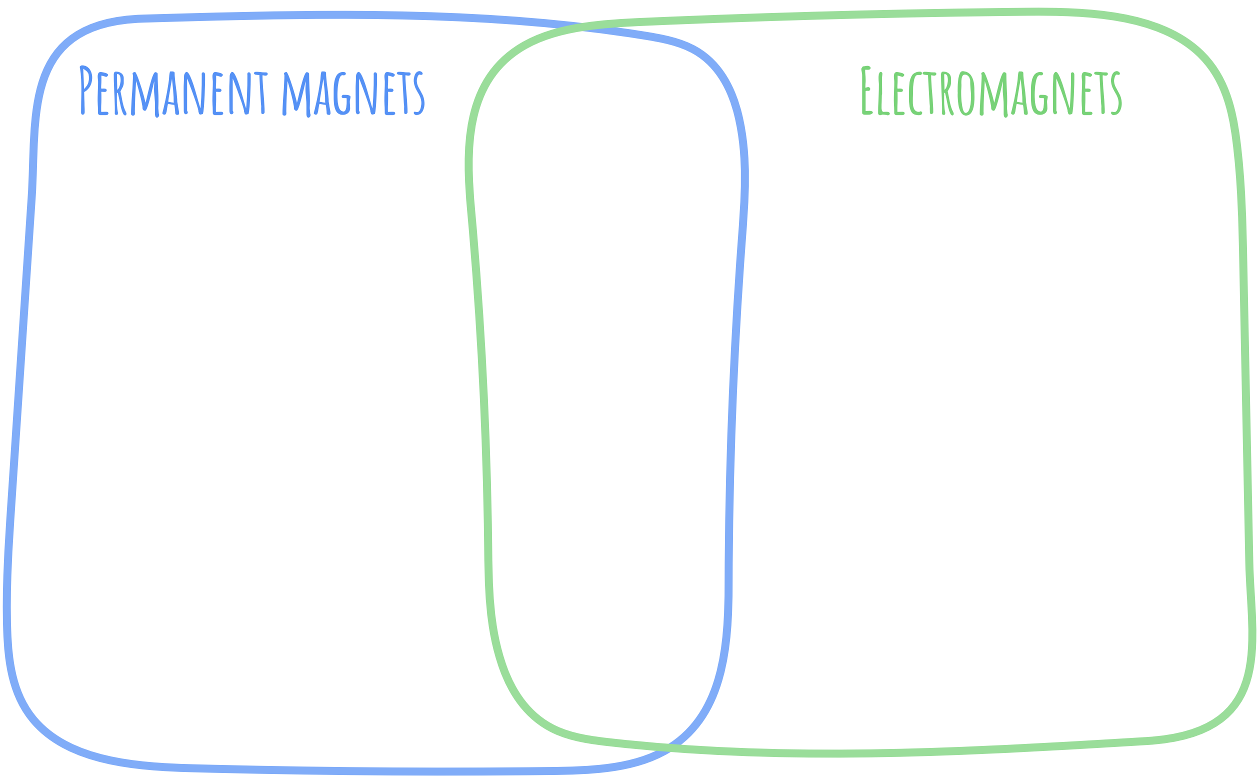
Name:	Hand in instructions:

ELECTROMAGNETS

1. Comparing permanent magnets and electromagnets

- **Read each of the numbered statements below**
- **Decide if each one applies to permanent magnets, to electromagnets, or to both types of magnet**
- **Write the number of each statement in the correct area of the blank Venn diagram below**

1. Require an electric current to work
2. Are surrounded by an invisible magnetic field
3. Can be switched on and off
4. Have a North Pole and a South Pole
5. Can be made stronger or weaker
6. Remain magnetic all the time
7. Usually have a soft iron core that's inside a solenoid
8. Are found in electric motors
9. Attract magnetic materials
10. Are used in power station generators



2. How does an electromagnetic bell work?

- **You may have a school bell or fire alarm that uses an electromagnet and works in the same was as the example shared below.**
- **Rearrange the steps into the correct order (it's not A, B, C etc!) to explain how an electromagnetic bell works – we've done the first one for you.**

A As the metal arm (hammer) is pulled towards the electromagnet, it's pulled away from its contact with the series circuit.

B The metal arm (hammer) is attracted to the electromagnet.

C A current flows through the electromagnet again. The metal arm is attracted again, hitting the gong and making a second single noise.

D The circuit is broken, there's no current flowing through the coil, and the electromagnet turns off.

E This process repeats over and over again.

F The switch is closed. An electric current flows through the electromagnet, producing a magnetic field.

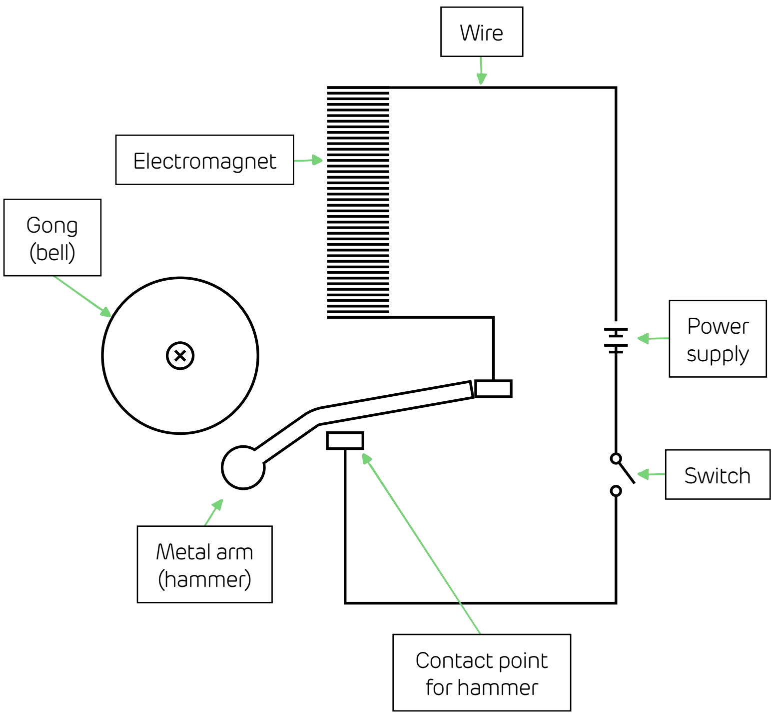
G The switch is open and the metal arm is away from the gong.

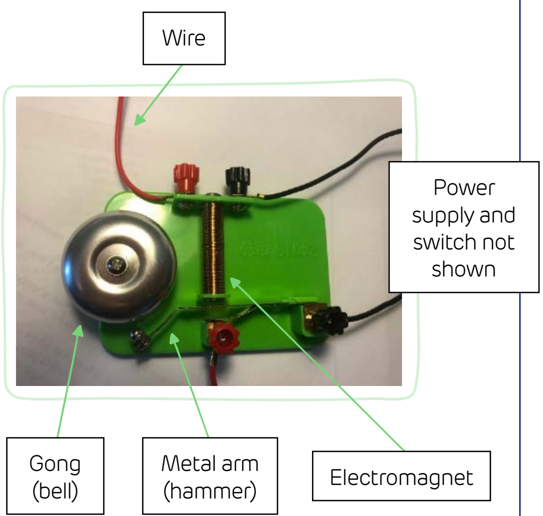
H The repeated rapid strikes of the gong are the ringing noise of the bell.

I The metal arm (hammer) springs back. The contacts touch and the circuit is complete again.

J The metal arm (hammer) hits the gong, which makes a single sound.

Correct order	Step
1	G
2	
3	
4	
5	
6	
7	
8	
9	
10	





3. Planning a magnetic investigation

- You're going to to test a hypothesis by conducting a scientific investigation.
- You should include:
    - The steps you'd take (in a logical order!)
    - All of the scientific variables
    - A circuit diagram
    - How you could record your results
- We've added some helpful hints on page 5 – challenge yourself first by trying without the hints.

Hypothesis	Adding five more turns on a solenoid always makes a simple electromagnet stronger.
Equipment	Iron nail, long plastic-coated copper wire, connecting wires, paperclips, 4 'AA' sized batteries in holders, crocodile clips
Control variables	
Independent variable	
Dependent variable	

Method (use bullet points)

Circuit diagram

Recording results

Helpful hints for 'Planning a magnetic investigation'

Hypothesis

Scientists use hypotheses (one hypothesis, many hypotheses) to explain things they observe. It's possible to test hypotheses to establish whether or not a variable has an effect upon another variable, and determine the relationship between the variables. In practical work, a hypothesis is a prediction that you support with an explanation.

You need to design your investigation to prove whether the following hypothesis is true or false:

- **'Adding five more turns on a solenoid always makes a simple electromagnet stronger.'**
- A 'turn' means wrapping a long wire once around a core.
- A 'solenoid' is a long coil of wire.

Control variables

These are the factors in your experiment that you always keep the same, every time you repeat the experiment. This means they'll never influence the results of your experiments.

Independent variable

This is the one factor in your investigation that you change.

Dependent variable

This is the variable that you measure and record.

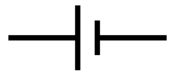
Method

- A method is a set of instructions that someone else could read to replicate (copy) your experiment
- Make sure your instructions follow a step-by-step, logical order and u to describe each step (as in the example below)
    - Make an electrical circuit the same as the one in the diagram
    - Add an extra turn to the solenoid
    - Test the strength of the electromagnet by...
    - Add another turn to the solenoid
    - Test the electromagentic's strength in the same way you did in step two
- When writing your method, include changing the number of turns on the solenoid, and how to test the strength of the electromagnet each time

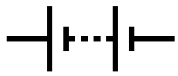
Circuit diagram

To draw your diagram, you'll need to use standard symbols for the components:

- Use straight lines to represent connecting wires
- Complete the circuit (make sure there are no gaps)
- Use right angles (because it's a square or rectangle!)
- Draw the solenoid as a spiral of wire



Cell



Battery of cells

Recording results

You could record and present your results in a table like this:

INDEPENDENT VARIABLE	DEPENDENT VARIABLE

4. Research challenge

- **The following webpage links should be useful for finding some facts about electromagnets:**
  - www.drax.com/technology/magnets-metal-motion-electricity-generation-simplified/
  - www.drax.com/technology/electricity-magnetism-relationship-makes-modern-world-work/
  - www.drax.com/technology/refurbishing-300-tonne-generator-core-within-heart-power-station/
- **Describe the industrial electromagnets in an electrical generator:**

- **Try to find all the following facts:**

1. Name the British scientist who first discovered that a moving magnetic field could induce an electric current in a wire.

2. What are the main components (parts) of a power station generator?

3. How big are the spinning electromagnets in each of the generators at Drax Power Station?

4. Most types of electricity generation use a spinning turbine, with a spinning magnet inducing an electrical current inside copper metal around the magnet. Name a type of power generation that doesn't use a spinning turbine.

5. What's the 'stator' in an electrical generator?

6. How long are each of the copper bars in the stators inside the Drax Power Station generators, and how are they kept cool?

7. What's a 'Kibble balance', and what's it got to do with electromagnets?

8. All the turbines generating electricity in the UK, regardless of who operates them or what powers them, have to spin at the same speed. How fast do they turn?

9. How does the electricity generated by power stations reach homes and businesses?

10. In 2016, Drax Power Station carried out work to 'rewind' a copper stator. Why did this work need special, very clean conditions?