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1. Introduction

This kit recreates Michael Faraday's 1831 discovery that moving a magnet near a coil of wire can generate electricity. Pupils use real scientific equipment — copper coils, magnets, galvanometers, motors, and compasses — to explore electromagnetic induction hands-on.

Designed for **KS2–KS3**, this guide supports lessons, STEM days, clubs, and home learning.

[Placeholder: Illustration of Faraday's experiment — magnet + coil + galvanometer]

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2. The Science Behind the Experiment

2.1 Electromagnetic Induction

A **changing magnetic field** creates an electric current in a conductor.

- Move a magnet into a coil → current
- Move a magnet out → current (opposite direction)
- Hold the magnet still → no current

[Placeholder: Diagram — magnet moving through coil with arrows showing current direction]

2.2 What Happens Inside the Wire

Electricity is the movement of **electrons**.

- Electrons move freely through metal
- Protons stay locked in the nucleus
- Neutrons have no charge

Only electrons respond to the magnetic field.

[Placeholder: Simple atom diagram — electrons vs nucleus]

2.3 Energy Transfer & The First Law of Thermodynamics

This experiment is a perfect demonstration of the **First Law of Thermodynamics**:
Energy cannot be created or destroyed — only transformed.

When pupils move the magnet:

- Their **kinetic energy** (movement)
- Is converted into **electrical energy** in the coil
- Which is detected by the galvanometer
- Or used to power the motor

This principle was developed by **James Prescott Joule**, **Hermann von Helmholtz**, and **Rudolf Clausius** in the mid-1800s.
Faraday discovered induction first, and their work later explained the **energy conversion** happening inside the coil.

[Placeholder: Energy flow diagram — movement → induction → electricity]

2.4 Faraday → Maxwell → Einstein

- **Faraday (1831)** discovered induction
- **Maxwell (1860s)** unified electricity and magnetism mathematically
- **Einstein (1905)** showed that induction works the same whether the magnet moves or the coil moves, using special relativity

Einstein credited Faraday's experiment as a major inspiration.

[Placeholder: Timeline graphic with portraits]

2.5 Real-World Applications

Every generator — wind turbines, power stations, bike dynamos — uses this principle.

[Placeholder: Illustration of a generator or turbine]

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3. What Pupils Will Learn

- How electricity is generated by moving a magnet near a coil
- That electric current is the movement of electrons
- How energy transfers from motion to electricity
- How to read a galvanometer
- How to predict, test, observe, and explain results

- How Faraday's discovery links to modern electricity generation

Includes a printable Pupil Worksheet.

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4. Curriculum Links (KS2–KS3)

KS2

- Electricity: circuits, conductors, switches
- Forces & Magnets: magnetic fields, attraction/repulsion
- Working Scientifically: prediction, observation, recording

KS3

- Electricity & Magnetism: current, fields, induction
- Energy: transfer and conservation (Joule, Helmholtz, Clausius)
- Matter: electrons vs protons/neutrons
- Scientific Enquiry: variables, fair testing, data interpretation

[Placeholder: Curriculum mapping table]

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5. Enquiry-Based Learning Sequence

Step 1 — Predict

What happens when the magnet moves fast, slow, or not at all?

Step 2 — Observe

Watch the galvanometer needle move.

Step 3 — Test Variables

- Speed
- Number of magnets
- Distance
- Direction
- Coil orientation

Step 4 — Explain

Use magnetic fields, electron movement, and energy transfer.

[Placeholder: Diagram — galvanometer needle deflection]

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6. What's Inside the Kit

- Copper Coil
- Ring Magnets (x6)
- Galvanometer
- Connecting Wires (x2)
- Motor + Propeller
- Compass
- Levitation Pole

[Placeholder: Flat-lay photo or labelled diagram of kit components]

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7. Safety Guidance

- Suitable for ages **7+** with normal supervision
- Magnets are strong but low-risk
- Keep magnets away from electronics and small children
- No mains electricity or batteries required
- All components safe for classroom and home use

[Placeholder: Safety icons]

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8. Extension Activities

8.1 Powering a Motor

Use generated electricity to spin the motor.

8.2 Mapping Magnetic Fields

Use the compass to explore field direction and strength.

8.3 Levitation Pole

Investigate magnetic repulsion and balanced forces.

8.4 Coil Orientation

Test how rotating the coil affects induction.

8.5 Real-World Links

Research wind turbines, dynamos, and generators.

[Placeholder: Diagram — motor spinning from induced current]

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9. Historical Timeline

- **1820s** — Oersted links electricity and magnetism
- **1831** — Faraday discovers induction
- **1840s–1860s** — Joule, Helmholtz, Clausius develop energy conservation
- **1860s** — Maxwell unifies electricity and magnetism
- **1880s** — Generators spread worldwide
- **1905** — Einstein explains induction symmetry

[Placeholder: Illustrated timeline]

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10. Summary

This kit gives pupils a rare chance to recreate a world-changing scientific discovery using real equipment. They learn how electricity is generated, how energy transfers, and how modern power systems work — all through hands-on exploration.

Includes:

- Full Teacher's Guide
- Printable Pupil Worksheet
- Clear safety notes
- Extension activities
- Curriculum alignment

[Placeholder: Final illustration or classroom photo]
