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## Faraday Experiment — How It Works (Version 1.0)

*Young Einstein Science Kits*

*Ages 7+ · Premium Minimal Edition*

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### 1. Introduction

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

Designed for **KS2–KS3**, the activity supports science lessons, STEM days, clubs, and home learning.

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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.

- Magnet moves **into** the coil → current
- Magnet moves **out** → current in the opposite direction
- Magnet held still → **no current**

This is Faraday's Law of Induction — the foundation of modern electricity generation.

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#### 2.2 What Happens Inside the Wire

Electricity is the movement of **electrons**.

- Electrons move freely through metals
- **Protons and neutrons stay tightly packed in the nucleus — they do not move during this experiment**
- Only electrons respond to the changing magnetic field

A changing magnetic field pushes electrons through the coil, creating a measurable current.

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## 2.3 Energy Transfer

This experiment demonstrates the First Law of Thermodynamics: **energy cannot be created or destroyed — only transferred.**

When pupils move the magnet:

- Their **kinetic energy**
  - Converts into **electrical energy** in the coil
  - Detected by the galvanometer or used to power the motor
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## 2.4 Faraday → Maxwell → Einstein

- **Faraday (1831):** discovered induction
- **Maxwell (1860s):** unified electricity and magnetism
- **Einstein (1905):** showed induction works the same whether the magnet moves or the coil moves

Einstein credited Faraday's experiment as a major inspiration.

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## 2.5 Real-World Applications

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

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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 power generation

A printable **Pupil Worksheet** is included.

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## 4. Curriculum Links

## 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
  - Matter: electrons vs protons/neutrons
  - Scientific Enquiry: variables, fair testing, data interpretation
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## 5. Enquiry-Based Learning Sequence

**Predict** — What happens when the magnet moves fast, slow, or not at all

**Observe** — Watch the galvanometer needle move

**Test Variables** — Speed, number of magnets, distance, direction, coil orientation

**Explain** — Use magnetic fields, electron movement, and energy transfer

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## 6. What's Inside the Kit

- Copper Coil
  - Ring Magnets (x6)
  - Galvanometer
  - Connecting Wires (x2)
  - Motor + Propeller
  - Compass
  - Levitation Pole
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## 7. Age & Safety Guidance

**Designed for ages 7+ with normal classroom or home supervision.**

All components are safe for handling, and the activity uses low-risk magnets and simple circuits.

**Caution:** Contains small magnets. Individuals with pacemakers or implanted medical devices should avoid close, prolonged contact.

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## 8. Extension Activities

- **Powering a Motor** — Use generated electricity to spin the motor
  - **Mapping Magnetic Fields** — Explore field direction and strength
  - **Levitation Pole** — Investigate magnetic repulsion and balanced forces
  - **Coil Orientation** — Test how rotating the coil affects induction
  - **Real-World Links** — Research wind turbines, dynamos, and generators
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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

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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
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