

## Physics: Electromagnetism

### Whole unit overview

Learning Outcomes		Suggested Teaching Activities	Resources
4.1	<p>State the properties of magnets.</p> <p>Give an account of induced magnetism.</p> <p>Distinguish between ferrous and non-ferrous materials.</p> <p>Describe methods of magnetisation and of demagnetisation.</p> <p>Describe an experiment to identify the pattern of field lines round a bar magnet.</p> <p>Distinguish between the magnetic properties of iron and steel.</p> <p>Distinguish between the design and use of permanent magnets and electromagnets.</p>	<p>Simple experiments with magnets to show attraction and repulsion, leading to investigation of the field patterns round bar magnets (individually and between attracting poles and between repelling poles).</p> <p>Extend to show the direction of the field lines using a plotting compass.</p> <p>Make and use a simple electromagnet.</p> <p>Experiments to magnetise and demagnetise samples of iron by mechanical and electrical means.</p>	<p>This site called 'Gallery of Electromagnetic Personalities' contains brief histories of 43 scientists who have made major contributions, from Ampere to Westinghouse. <a href="http://www.ee.umd.edu/~taylor/frame1.htm">http://www.ee.umd.edu/~taylor/frame1.htm</a></p> <p>This site has a very full lesson plan including making an electromagnet. <a href="http://school.discovery.com/lessonplans/">http://school.discovery.com/lessonplans/</a></p> <p>Click on Physical Science, then Electricity</p>
4.5 (a)	<p>Describe an experiment which shows that a changing magnetic field can induce an e.m.f. in a circuit.</p>	<p>Experiment moving a permanent magnet in and out of a coil, connected to a sensitive meter. This can be extended to show the same effect using an electromagnet moved in and out of the coil and then by simply switching the electromagnet on and off.</p>	
	<p>State the factors affecting the magnitude of an induced e.m.f.</p> <p>Show understanding that the direction of an induced e.m.f. opposes the change causing it.</p>	<p>Extend the experiments above to show the effects of the strength of the field (use a stronger permanent magnet or increase the current in the electromagnet), the speed of movement and the number of turns per metre in the coil.</p>	

4.5 (b)	<p>Describe a rotating-coil generator and the use of slip rings.</p> <p>Sketch a graph of voltage output against time for a simple a.c. generator.</p>	Make a working model generator.	<p>This site describes the working of an a.c. generator.</p> <p><a href="http://www.pbs.org/wgbh/amex/edison/sfeature/acdc_insideacgenerator.html">http://www.pbs.org/wgbh/amex/edison/sfeature/acdc_insideacgenerator.html</a></p>
4.5 (c)	<p>Describe the construction of a basic iron-cored transformer as used for voltage transformations. Recall and use the equation <math>(V_p/V_s) = N_p/N_s</math>.</p> <p>Describe the use of the transformer in high-voltage transmission of electricity.</p> <p>Give the advantages of high voltage transmission.</p>	Make a working model transformer (two 'C-cores' with suitable wire windings) to introduce the ideas and follow with a demonstration (demountable) transformer.	
	<p>Describe the principle of operation of a transformer.</p> <p>Recall and use the equation <math>V_p I_p = V_s I_s</math> (for 100% efficiency).</p> <p>Discuss the energy loss in cables.</p>		
4.5 (d)	<p>Describe the pattern of the magnetic field due to currents in straight wires and in solenoids.</p> <p>Describe applications of the magnetic effect of current, including the action of a relay.</p>	Use iron filings on a suitably placed card to show the field patterns round a straight wire and a solenoid. The direction of the field can be shown with a plotting compass. If a thin sheet of Perspex is used in place of the card the apparatus can be mounted on an overhead projector to give a class demonstration.	

	<p>State the qualitative variation of the strength of the magnetic field over salient parts of the pattern.</p> <p>Describe the effect on the magnetic field of changing the magnitude and direction of the current.</p>	<p>Extend the experiments to show the effect of changing the magnitude and direction of the current (separation of lines of iron filings and direction of plotting compass).</p>	
4.5 (e)	<p>Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing (i) the current, (ii) the direction of the field.</p>	<p>Use the 'catapult' experiment or similar.</p>	
	<p>Describe an experiment to show the corresponding force on beams of charged particles. State and use the relative directions of force, field and current.</p>	<p>Use a cathode ray tube to demonstrate these effects.</p>	
4.5 (f)	<p>State that a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by increasing the number of turns on the coil.</p> <p>Relate this turning effect to the action of an electric motor.</p>	<p>Make a model motor and investigate the effect of changing the number of turns.</p>	<p>Full instructions on how to make a working model d.c. electric motor from simple components.  <a href="http://www.exploratorium.edu/snacks/stripped_own_motor.html">http://www.exploratorium.edu/snacks/stripped_own_motor.html</a></p> <p>Explanation of how the motor works, with helpful illustrations.  <a href="http://www.howstuffworks.com/motor.htm">http://www.howstuffworks.com/motor.htm</a></p>
	<p>Describe the effect of increasing the current.</p>		