P7 Magnetism & Electromagnetism

What's the science story?

Electromagnetic effects are used in a wide variety of devices. Engineers make use of the fact that a magnet moving in a coil can produce electric current and also that when current flows around a magnet it can produce movement. It means that systems that involve control or communications can take full advantage of this.

Previous knowledge:

KS3 – Magnets
KS3 - Electricity

Next steps…

N/A

Keywords

Magnetic
Poles
Attract
Permanent

Repel
Magnetic field
Induced
Solenoid

Electromagnetism
Current
Magnetic flux density (HT)

Working scientifically skills:

WS2 - Draw/Interpret diagrams
WS3 - Make predictions - Make prediction using a model
WS4 - Ethical arguments - Rights and wrongs of technology
WS5 - Risk perception - Hazards of new technology

Assessments:

End of unit test (summative)
Exit tickets x 1 (formative)

- Exit ticket – Magnetic fields Exam Q

Lesson No. and Title	Learning objectives	AQA Specification	Practical equipment
1. Magnets & Magnetic fields	4 – State how magnets behave and identify shape of magnetic field. 6 – Describe the difference between permanent and induced magnets. 6 – Explain how compasses aid with direction.	**6.7.1.1 Poles of a magnet** The poles of a magnet are the places where the magnetic forces are strongest. When two magnets are brought close together they exert a force on each other. Two like poles repel each other. Two unlike poles attract each other. Attraction and repulsion between two magnetic poles are examples of non-contact force. A permanent magnet produces its own magnetic field. An induced magnet is a material that becomes a magnet when it is placed in a magnetic field. Induced magnetism always causes a force of attraction. When removed from the magnetic field an induced magnet loses most/all of its magnetism quickly. Students should be able to describe: • the attraction and repulsion between unlike and like poles for permanent magnets • the difference between permanent and induced magnets. **6.7.1.2 Magnetic fields** The region around a magnet where a force acts on another magnet or on a magnetic material (iron, steel, cobalt and nickel) is called the magnetic field. The force between a magnet and a magnetic material is always one of attraction. The strength of the magnetic field depends on the distance from the magnet. The field is strongest at the poles of the magnet. The direction of the magnetic field at any point is given by the direction of the force that would act on another north pole placed at that point. The direction of a magnetic field line is from the north (seeking) pole of a magnet to the south(seeking) pole of the magnet. A magnetic compass contains a small bar magnet. The Earth has a magnetic field. The compass needle points in the direction of the Earth's magnetic field. Students should be able to: • describe how to plot the magnetic field pattern of a magnet using a compass • draw the magnetic field pattern of a bar magnet showing how strength and direction change from one point to another • explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic.	DEMO – Magnetising an iron nail Iron nail, strong magnet and paperclips PRAC – Magnetic field lines Bar magnets and mini compasses

2. Electromagnetism	4 – Describe how the magnetic effect of a current can be demonstrated. 6 – Draw the magnetic field pattern for a straight wire carrying a current and for a solenoid. 8 – Explain how solenoid arrangement can increase the magnetic effect of current.	**6.7.2.1 Electromagnetism** When a current flows through a conducting wire a magnetic field is produced around the wire. The strength of the magnetic field depends on the current through the wire and the distance from the wire. Shaping a wire to form a solenoid increases the strength of the magnetic field created by a current through the wire. The magnetic field inside a solenoid is strong and uniform. The magnetic field around a solenoid has a similar shape to that of a bar magnet. Adding an iron core increases the strength of the magnetic field of a solenoid. An electromagnet is a solenoid with an iron core. Students should be able to: • describe how the magnetic effect of a current can be demonstrated • draw the magnetic field pattern for a straight wire carrying a current and for a solenoid (showing the direction of the field) • explain how a solenoid arrangement can increase the magnetic effect of the current.	PRAC – Testing electromagnets Wires to coil, iron nails, wires with croc clips, power packs, paper clips
3. HT – Fleming's left-hand rule	6 – Recall Fleming's left hand rule and what it represents 8 – Recall factors that affect the size of the force on the conductor.	**6.7.2.2 Fleming's left-hand rule (HT only)** When a conductor carrying a current is placed in a magnetic field the magnet producing the field and the conductor exert a force on each other. This is called the motor effect. Students should be able to show that Fleming's left-hand rule represents the relative orientation of the force, the current in the conductor and the magnetic field. Students should be able to recall the factors that affect the size of the force on the conductor. For a conductor at right angles to a magnetic field and carrying a current: force = magnetic flux density × current × length $F = B\,I\,l$ force, F, in newtons, N magnetic flux density, B, in tesla, T current, I, in amperes, A (amp is acceptable for ampere) length, l, in metres, m	DEMO – Foil or wire movement to show motor effect Strong magnets, power pack, thin wire or foil, wore with croc clips
4. HT – Electric Motors	6 – Know the basis of an electric motor. 8 – Explain how the force on a conductor in a magnetic field causes the rotation of the coil in a motor.	**6.7.2.3 Electric motors (HT only)** A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an electric motor. Students should be able to explain how the force on a conductor in a magnetic field causes the rotation of the coil in an electric motor	