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| **Subject:** | **Class:** |
| **Teacher:** |  |
| **Duration: Approx. 14 lessons** | |
| **Title: Electricity and Magnetism** | |
| **Intention: What is the topic teaching and why?**  Making circuits, testing and using circuits. Current and voltage, modelling current and voltage. | |
| **Implementation? List of topics, skills and behaviours covered.**  Circuit symbols  Making simple series and parallel circuits  Qualitative understanding of current and resistance  Modelling electric current  Static electricity  Magnets and electromagnets | |
| **Impact: Assessment and feedback points** | |
| **Links to GCSE:** | |

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| Lesson | Topic | WALT | Key Vocabulary | | Skills and behaviours | Engagement |
| Skills | Content |
| 1 | Introduction to building circuits | Be able to use UniLab electricity equipment to construct simple circuits | To be able to fault find electrical components.  To identify different electrical components and to be able to correctly use them in simple circuits. | Components, matching the name to the component.  Fault finding – it doesn’t work! (PowerPoint)  Making simple circuits and checking that they work.  Identifying where to put components in a circuit – can they just go anywhere. | Perseverance in constructing simple circuits.  Handling of apparatus and the skills needed to set up simple circuits. | Vibrating cup robots (cell, motor, wire, lamp) |
| Suggested Practical activities | | | | | | Misconceptions and common errors |
| * Fault finding – does the lamp work, are my cells dead, is there a problem with a cable? * Matching components to photos and symbols (PowerPoint and cards) * Making simple circuits * Making more complicated circuits based on diagrams * Making a vibrating cup robot | | | | | | It doesn’t work – students connect cells in series the wrong way round.  Lamps – if students are using 3V lamp and put 6V across them  Relating curved wires to straight lines on a circuit diagram. |

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| 2 | “The big circuit” | To start to think about the problem of understanding how an electric circuit works.  To identify prior knowledge  To understand what is meant by a scientific model | Developing a conceptual model of a problem. | Lesson 1 from Teaching Science for Understanding: Electric circuits (University of Leeds)  Activities   * 1. Thinking again about electric circuits   2. The Big circuit   3. The supermarket picture | This lesson is focused on students starting to put together their own conceptual model of electric current. They will be encouraged to use a model to think about abstract concepts. |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| **Students do not need their exercise books for the lesson**  Students will be given their “Electric circuits” workbook at the start of the lesson and will complete:  Sheet 1.1 “A very simple electric circuit”  Sheet 1.2 “Open and close”  Sheet 1.3 “The supermarket picture”  Sheet 1.4 “Drawing your own supermarket picture”  Sheet 1.5 Summary questions | | | | | |  |

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| 3 | “Current” | To understand how the supermarket model can be used to model electric current in a circuit. | To be able to set up a series circuit and measure the current correctly in different parts of the circuit.  Recording measurements | Lesson 2 from Teaching Science for Understanding: Electric circuits (University of Leeds)  Activities  2.1 Electric circuits and supermarkets revisited  2.2 Predicting and measuring electric currents | Handling equipment,  Fault finding |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| **Students do not need their exercise books for the lesson**  Students will be using their “Electric circuits” workbook lesson and will complete:  Practical 2.2 Predicting and measuring electric currents (record results on sheet 2.1)  Demonstration of sheet 2.3 (The Big circuit) and complete sheet 2.2 | | | | | |  |

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| 4 | “Resistance” | To understand why the current goes down when a second light bulb is added to the circuit.  To introduce the concept resistance | To be able to set up a series circuit and measure the current correctly in different parts of the circuit.  Recording measurements | Lesson 3 from Teaching Science for Understanding: Electric circuits (University of Leeds)  Activities  3.1 Which supermarket picture fits best?  3.2 The concept of resistance  3.3 Bulbs in series  3.4 Adding resistance | Handling equipment,  Fault finding |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| **Students do not need their exercise books for the lesson**  Students will be using their “Electric circuits” workbook lesson and will complete:  Sheet 3.1 Which supermarket model fits best?  Sheet 3.2 Practical “Two bulbs, how bright is that?” and record findings on sheet  Sheet 3.3 Practical “Adding resistance” – and record findings on sheet | | | | | |  |

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| 5 | Investigating resistance | To carry out an investigation into how the material current flows through affects the resistance. | Taking measurements  Recording results appropriately in a table | This lesson follows on from the short investigation. | Collecting results  Team work  Presenting findings appropriately |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| This task is to be completed on the A3 planning sheets.  Students will set up a simple series circuit with an ammeter and lamp. Students will measure the current flowing through a range of different metal and non-metal objects. Students will design their own results table.  Students should be encouraged to complete the method and diagram as an extension. | | | | | |  |

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| 6 | “Voltage” | To understand the effect of adding extra cells to the circuit.  To be able to use our model of the supermarket to explain the results from this change. | To be able to set up a series circuit and measure the current correctly in different parts of the circuit.  Recording measurements | Lesson 4 from Teaching Science for Understanding: Electric circuits (University of Leeds)  Activities  4.1 Back to the idea of resistance  4.2 Adding cells to the circuit | Handling equipment,  Fault finding |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| **Students do not need their exercise books for the lesson**  Students will be using their “Electric circuits” workbook lesson and will complete:  Sheet 4.1 To be able to use the supermarket model to explain what happens when you add extra resistance into a circuit.  Sheet 4.2 Practical: Adding cells to the circuit  Sheet 4.3 Putting our ideas together | | | | | |  |

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| 7 | Series and parallel circuits | To be able to identify and construct a series and parallel circuit.  To be able to qualitatively state what happens when you add more bulbs in a series and parallel circuit | To be able to use the uni-lab apparatus to make series and parallel circuits. | QUALITATIVE PRACTICAL – investigating series circuits.  QUALITATIVE PRACTICAL – investigating parallel circuits.  To be able to identify the difference between a series and a parallel circuit from diagrams and from models. | Handling equipment,  Fault finding |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| These activities are meant to be qualitative and do not require students to take measurements.  Students make the following circuits (carefully) and observe what happens to the brightness of the bulbs. Students should also correctly draw the circuits in their books.  1 lamp, followed by 2, 3 and 4 lamps in series  1 lamp, followed by 2,3 and 4 lamps in parallel. | | | | | |  |

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| 8 | “Potential difference” | To be able to use a model to explain the term potential difference. |  | Key questions;  What is voltage?  What is potential difference?  How do we measure potential difference? |  |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| Increasing the potential difference through a 12V lamp, what happens to the brightness of the lamp?  What can you say about the amount of energy the bulb must be transferring as the potential difference is increased?  *Potential difference is a measure of the difference in energy between two parts of a circuit. The bigger the difference in energy, the bigger the potential difference.*  Practical: Using a voltmeter correctly to measure the potential difference in a circuit.  *Potential difference is measured using a device called a voltmeter. Just like ammeters, some types have a pointer on a dial, but most have a digital display. However, unlike an ammeter, you must connect the voltmeter in parallel to measure the potential difference across a component in a circuit.* | | | | | | Potential difference is measured in volts. The symbol for volts is V. For example, 230 V is a bigger potential difference than 12 V. Instead of talking about potential difference, people often talk about voltage, so you may hear or see ‘voltage’ instead of ‘potential difference’. |

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| 9 | Static electricity | Some particles carry an electric charge. In electric wires these particles are electrons.    We get an electric current when these charged particles move from place to place. |  | When two objects are rubbed together, electrons are transferred from one object to the other. One object becomes positive and the other negative. A non-contact force exists between charged objects. |  | Whilst the Van daar Graaf is one of the most exciting activities – please avoid doing it! We will be using it at GCSE. |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| Lots of fun and engaging practical activities can be carried out.  Rubbing balloons together etc. | | | | | |  |

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| 10 | Magnets | To be able to identify magnetic materials.  To be able to identify the rules of attraction and repulsion. |  | Brainstorm uses of magnets in every day life.  Practical: Investigating magnetic materials  Rules of attraction and repulsion. |  | Levitating paper clip  Hovering rings  Fun activity: identify all the magnetic materials in the classroom. |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| Identifying magnetic materials: Students use a permanent magnet to classify objects as either magnetic materials or non-magnetic materials. | | | | | | All permanent magnets are made from magnetic materials whereas not all magnetic materials are magnets. |

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| 11 | Magnetic field lines and patterns | Understand that there is an inviable magnetic field around a magnet and that magnetic objects placed in this field will experience a force. |  | Demo the attraction and repulsion of a pair of magnets and discuss what can be seen. Explore the idea that there must be a force involved.  Drawing magnetic field lines from experimental results. |  | Fun practical – drawing the magnetic field using iron filings. |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| Identifying where the magnetic field strength is the strongest (how close does the paper clip need to be before it is attracted)  Plotting the magnetic field with plotting compasses or iron filings | | | | | | Students find it hard to visualise the magnetic field lines exist in all planes around the magnet. |

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| 12 | Electromagnets | To understand how to make an electromagnet. |  | Is it possible to switch on or off a magnet?  Use example of maglocks.  Making a solenoid.  Making and testing an electromagnet. |  | Looking at real life examples of magnets and electromagnets. |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| Students make a solenoid by wrapping a wire around either a nail, soft iron core or C-shaped core. Students draw a diagram of the solenoid. Test – does it pick up a paperclip.  Connecting a power pack (be careful with the voltage) and testing – does it pick up a paperclip? | | | | | | The difference between a solenoid and an electromagnet. |

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| 13 | Electromagnets investigation (1) | To carry out an investigation into the factors that affect the strength of an electromagnet. | Skills to be assessed during this unit:  Collecting data  Results tables | The main aim of the next two lessons is to carry out an investigation into the factors that affect the strength of an electromagnet. | Carrying out an investigation. | The context for the two lessons could be based around “Who can make the strongest electromagnet?” |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
| The investigation will be focusing on Collecting data and producing results tables. With some groups you may want to direct the students towards the IV and CV for the experiment. In other groups you may want to give the students choice over which IV they would like to investigate.  Possible IV: Number of turns of wire, voltage, material used for the core | | | | | |  |

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| 14 | Electromagnets investigation (2) |  |  | Complete practical task and write up. |  |  |
| Suggested Practical activities and resources | | | | | | Misconceptions and common errors |
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