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| **3. Current  LESSON PLAN**  **—** | | |
| **PROJECT ACTIVITY**  **1.** Please [click here to view the EEF Teaching and Learning Toolkit strand on Metacognition & Self-regulation](https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/meta-cognition-and-self-regulation/)  **2.** Please follow this [link](https://docs.google.com/forms/d/e/1FAIpQLSd_E09XugVuwkTm8atw_c7l6YxMQ5Mb91vxGB8kYQhP_-Fl6Q/viewform?pli=1) to answer the questions below.  **a.** (Multiple choice) To what extent do you think your year 7/8 pupils already habitually plan, monitor and evaluate their own learning effectively?  **b.** (Optional) Please share any examples/ideas that you have for explicitly teaching pupils how to plan, monitor and evaluate their own learning.  Please note:   * These ideas do not have to be for Yr7/8 electric circuits * If you are interested, you can find more information in the [guidance report](https://educationendowmentfoundation.org.uk/tools/guidance-reports/metacognition-and-self-regulated-learning/) on this topic, as well as in recommendation 2 of the [EEF Improving Secondary Science Guidance Report](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=14)). | | |
| **LESSON SUMMARY**  In lesson 1 the concept of ‘something’ flowing around a loop is introduced. Here this is expanded to a more detailed explanation of what this ‘something’ is | | (electric current) and how it can be measured. Students are then asked to identify and correct common misconceptions. |
| **OBJECTIVES** | **1.** Measure current  **2.** Understand what is flowing in a circuit | |
| **EQUIPMENT LIST** | **•**  PRACTICAL TASK: Each group to receive 1 cell, 2 bulbs, an ammeter and 5 wires. Ideally students will work in pairs, but groups could be up to 4 students. | |
| **RESOURCES** | **•**  PowerPoint presentation  **•**  Worksheet  **•**  PhET | |
| **DIFFERENTIATION/**  **ADAPTATIONS** | **•**  Practical activity can be done virtually using PhET | |

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| **TIMETABLE & DESCRIPTION OF ACTIVITIES** | | |
| TIME  ACTIVITY  RESOURCES | DESCRIPTION | RESEARCH |
| 00:00 – 00:10  Starter  PowerPoint | **Slide 6:**  Interleaved questions | 4c. Memory: Provide opportunities for pupils to retrieve knowledge they previously learnt. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=26) |
| 00:10 – 00:35  Measure current  Practical equipment (per group):   * 1 cell * 5 wires * 2 bulbs (ideally but not necessarily different) * 1 ammeter   PhET  PowerPoint  Worksheet | **Slide 9:** Explain and show an ammeter. Students copy down definition and symbol.  **Slide 10**: Students represent drawing of circuit as a circuit diagram, following the rules learned in Lesson 2. AFL in following slide – hands up who got it right?  **Practical (Task 1):** Build a circuit containing a battery and 2 bulbs and measure the current at every point.  There is a checklist for students to fix their own circuits if they don’t work, but you will need to circulate the room to help them in case there are dead batteries, blown bulbs etc.  NB ideally the two bulbs used by each group are non-identical – if they are the same you will need to make sure you point out that the current being the same everywhere does NOT mean it is being shared evenly between the bulbs!  The practical should be demonstrated on [PhET](https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab) (screenshot included on slide). While demonstrating, discuss how you are making sure the only thing you are changing is the position of the ammeter.  Script for demonstration:  “You will need a battery, two bulbs, 5 wires and an ammeter (lay these out on screen as shown)”  “How should these components be connected as shown in the circuit diagram?” – student contribution, corrected by other students if necessary. You could make deliberate mistakes, such as leaving a gap, and ask the class why the bulbs won’t light up.  Demonstrate the procedure of replacing wires with ammeter, writing down the reading (being clear that their reading will be different!) and then replacing the ammeter with the original wire again.  5 minutes before the end of the activity all students to stop what they are doing and tidy up equipment as rehearsed in previous lesson. | 6b. Language of science: Show the links between words and their composite parts – ammeter means amp-meter [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=34)  4c. Memory: Provide opportunities for pupils to retrieve knowledge they previously learnt – Using frequent, short, and, importantly, low-stakes tests causes pupils to retrieve knowledge on a regular basis. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=26)  5d. Practical work: Use a variety of approaches to practical science - Virtual experiments should not replace the real thing, but they can support it. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=31)  2a. Self-regulation: Explicitly teach pupils how to plan, monitor, and evaluate their learning – Students are trained to troubleshoot electrical circuits – this both reinforces learning and allows future experiments to be carried out with greater efficiency. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=15)  5c. Practical work: Use practical work to develop scientific reasoning - Even if the main purpose of the experiment is to develop a particular scientific theory or a scientific skill, you can point out how you are using scientific methodology. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=30)  Misconceptions research on IOP Spark: Many pupils are unable to connect an ammeter in a circuit correctly. [Link](https://spark.iop.org/many-pupils-are-unable-connect-ammeter-circuit-correctly)  Misconceptions research on IOP Spark: Many students think that electric current or electric charge (or ‘electricity’), rather than energy, is stored in a battery. [Link](https://spark.iop.org/many-students-think-electric-current-or-electric-charge-or-electricity-rather-energy-stored-battery) |
| 00:35 – 00:50  Understand what is flowing in a circuit.  PowerPoint  Worksheet | **Slide 14:** Students copy down the definition of current.  **Task 2:** Students read through 4 statements, identify the incorrect ones (there are 2), state what misconception they show, and suggest an improved statement. They will do this in their books, giving you an opportunity to circulate.  **See slide notes for expected responses.** | Misconceptions research on IOP Spark: It is common for students to use the term ‘electricity’ in an ambiguous fashion that does not differentiate between the concepts of current, potential difference, energy and related terms with precise meaning. [Link](https://spark.iop.org/students-often-struggle-define-electricity-precisely)  Misconceptions research on IOP Spark: Some younger pupils hold a ‘consumer-source’ model of the simple circuit. [Link](https://spark.iop.org/some-younger-pupils-hold-consumer-source-model-simple-circuit)  Misconceptions research on IOP Spark: Some students have differing ideas about what is happening in the wires of an electric circuit when it is working. [Link](https://spark.iop.org/some-students-have-differing-ideas-about-what-happening-wires-electric-circuit-when-it-working)  2c. Self-regulation: Promote metacognitive talk and dialogue in the classroom - It is helpful to discuss wrong ideas and why they’re wrong, as well as why the right idea is right, and this helps pupils to examine their preconceptions. [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=16) |
| 00:55 – 01:00  Exit ticket  PowerPoint  Exit ticket, included at the end of the worksheet. | Students should pack away, then be given an exit ticket to complete individually and hand in on leaving the classroom.  **See slide notes for expected responses & misconceptions.** | 7a. Feedback: Find out what your pupils understand - It is important that you build up an accurate picture of the current understanding of all your pupils [Link](https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf#page=38)  Misconceptions research on IOP Spark: It is common for students to use the term ‘electricity’ in an ambiguous fashion that does not differentiate between the concepts of current, potential difference, energy and related terms with precise meaning. [Link](https://spark.iop.org/students-often-struggle-define-electricity-precisely) |