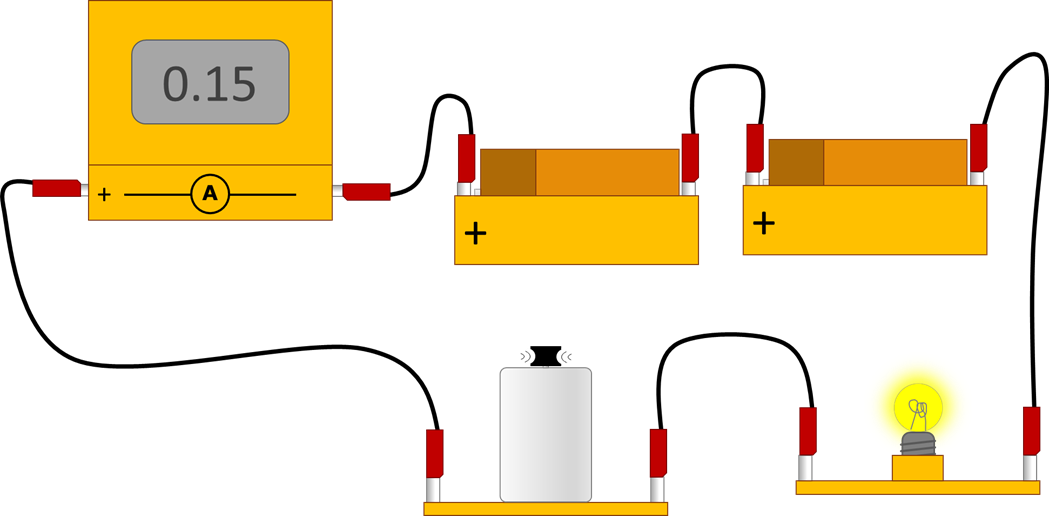
**Defining current**

Electric current is measured with an ammeter.

It is measured in amps (A).

An electric current flows through a complete circuit.



Each statement is a definition of electric current.

For each statement, tick (✓) **one** column to show what you think*.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | Current is the amount of energy transferred in 1 s. |  |  |  |  |
| **B** | current = charge x time (I = Q x t) |  |  |  |  |
| **C** | Current is the rate at which charge flows in a circuit. |  |  |  |  |

*Physics > Big idea PEM: Electricity and magnetism > Topic PEM8: Mains electricity > Key concept PEM8.2: Paying for electricity*

|  |
| --- |
| **Diagnostic question** |
| **Defining current** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | The amount of energy that an electrical appliance transfers is proportional to time; and its power is proportional to the potential difference across it and the current through it. |
| Observable learning outcome: | Explain the relationships I = Q/t and V = E/Q. |
| Question type: | Confidence grid |
| Key words: | Current, charge, time, ammeter, amp, coulomb, second |

**What does the research say?**

The understanding of why power can be calculated using P = I x V begins with the understanding of electric current as a flow of charge. This leads on to the introduction of relationship I = Q/t as a shorthand way of writing this down and of quantifying currents for comparison (Hartley, Fairhurst and Norris, 2021). The next step is to understand that potential difference is linked to energy because it (causes an electromagnetic field that) provides an electrical ‘push’.

Both I = Q/t and V = E/Q are derived from a microscope model of current that comprises charged particles caused to move by forces due to an electric field and impeded by collisions with microscopic structures and particles in a conductor (Liu et al., 2022). The two equations can be combined (I x V = Q/t x E/Q = E/t = P) to show that P = I x V; and the microscopic model of current used to explain the relationship.

**Ways to use this question**

Students should complete the confidence grid individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations, it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

Statement C is right; and statements A and B are wrong.

**How to respond - what next?**

Electric current is the rate at which charge flows in a circuit, which is the amount of charge that flows past a point in one second. Expressed as an equation: current (in amps) equals charge (in coulombs) divided by time (in seconds).

A It is common for students to not always distinguish carefully between energy, power, current and voltage, and some may use the terms interchangeably.

B Some students may have the misunderstanding that current is an amount of something (perhaps charge) that is *used up* by a component in a circuit.

Other students may recall the equation that relates current to charge and time wrongly (it is often introduced as Q = I x t).

C Students may think this statement is wrong if they misunderstand what is meant by a *rate* of something, or if they think wrongly that current is an amount of something that can be used up.

N.B. They may think this statement is correct if they hold *both* misunderstandings.

If students have misunderstandings about the definition of current, it can help to provide them with an opportunity to review their understanding of the relationship between charge and current, perhaps by using a rope-loop model.

The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Dotty rope

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images by Peter Fairhurst (UYSEG).

**References**

Hartley, R., Fairhurst, P. and Norris, T. (2021). Electricity and magnetism. In de Winter, J. & Hardman, M. (eds.) *Teaching secondary physics.* 3rd ed. London: Hodder Education.

Liu, Z., et al. (2022). Assessment of knowledge integration in student learning of simple electric circuits. *Physical Review Physics Education Research,* 18(2)**,** 020102.