**Circuit diagrams (2)**

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| --- | --- | --- | --- |
| Motor  Switch | |  |  |
| Albert set up this circuit. |  | Then he drew a circuit diagram |

Albert’s friend Barry said he had made lots of mistakes, but Albert thought it was a good diagram.

This a list of what Barry said he had done wrong.

Do you think each one is a mistake?

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Mistakes?** | | I am **sure** this is a mistake | I think this is a mistake | I think this is OK | I am **sure** this is OK |
| **A** | One of the batteries is the wrong way round |  |  |  |  |
| **B** | The wires to the motor are not drawn with a ruler |  |  |  |  |
| **C** | One of the circuit symbols is wrong |  |  |  |  |
| **D** | There are some little gaps in the circuit |  |  |  |  |
| **E** | The switch is in the wrong place |  |  |  |  |

*Physics > Big idea PEM: Electricity and magnetism > Topic PEM1: Simple electric circuits > Key concept PEM1.1 Making circuits*

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| --- |
| **Diagnostic question** |
| **Circuit diagrams (2)** |

**Overview**

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| --- | --- |
| Learning focus: | Electric circuits are represented using circuit symbols and specific circuit diagram conventions |
| Observable learning outcome: | * Use circuit symbols and circuit diagram conventions to draw clear and precise circuit diagrams of electrical circuits |
| Question type: | Diagnostic, confidence grid |
| Key words: | electric circuit, circuit symbol, switch, motor, connecting wire, bulb |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

Gott (1984) notes that most students are competent in recognising circuit symbols and using circuit diagrams to answer questions, but difficulties arise whenever students translate a circuit diagram into a real circuit and vice-versa. He goes further to suggest that students often think of a circuit diagrams as a map of a circuit, when in fact it is a stylised representation, drawn in a particular way to increase its clarity. This means that students commonly draw wires freehand rather than using ruled lines in a grid format.

Always using the same standard circuit symbols allows circuit diagrams to be understandable to scientists and engineers across the world. Students commonly conceive that their diagrams only need to be understandable to themselves or to their teachers. This leads to inexact representation of their circuit symbols.

**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**

A, B and C are mistakes

D and E are not

**How to respond - what next?**

One of the batteries is the wrong way round; and the circuit symbol for the switch is wrong because it has a line through it. Also the little gaps in the circuit are part of the correct circuit symbols for the batteries. Any uncertainty in these shows that the circuit symbols are not well remembered.

If students think it is OK for the wires to the motor to be drawn freehand, then they may be reacting to the unusual way the motor was drawn in the picture and reverting back to a less precise way of thinking about circuits.

The switch is in the correct sequence around the circuit, so it is drawn correctly. Those suggesting it is in the wrong place are thinking of the circuit as a map, and not as a clearer way of showing the sequence of connections.

If students have misunderstandings about using circuit symbols and circuit diagram conventions to draw clear and precise circuit diagrams of electrical circuits, then opportunities for them to practise drawing circuit diagrams and to be given focused feedback for them to respond to would be useful. The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Drawing circuits

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG)

Images: EPSE

**References**

Gott, R. (1984). *Electricity at age 15: a report on the performance of pupils at age 15 on questions in electricity*. London: Dept. of Education and Science, Welsh Office, Dept. of Education for Northern Ireland.