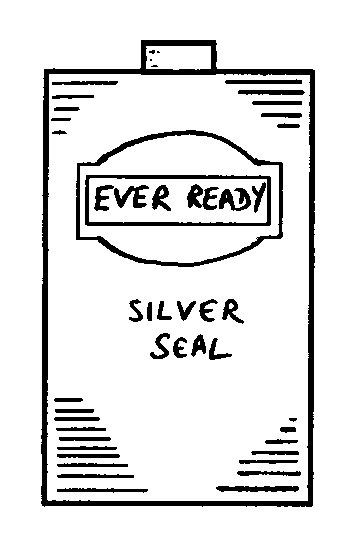
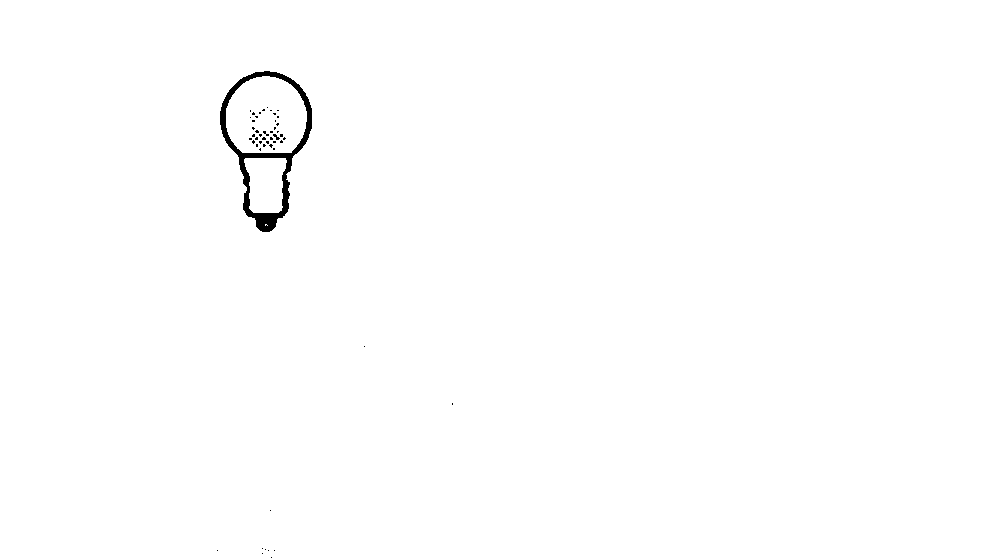
**Bulb in a circuit**



|  |  |  |
| --- | --- | --- |
| A torch battery has two contact points. It has one at each end. |  | A torch bulb has two contact points. One is at the tip and the other is on the screw thread. |

Look at the pictures below. They show different ways of connecting the battery and the bulb.

For each, tick one box (✓) to show if the bulb is lit or not.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **a.** | | | |  | **b.** | | | |  | **c.** | | | |
| **Lit** |  | **Not lit** |  |  | **Lit** |  | **Not lit** |  |  | **Lit** |  | **Not lit** |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **d.** | | | |  | **e.** | | | |  | **f.** | | | |
| **Lit** |  | **Not lit** |  |  | **Lit** |  | **Not lit** |  |  | **Lit** |  | **Not lit** |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Bulb in a circuit** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | An electric circuit is a closed conducting loop containing a battery. |
| Observable learning outcome: | * Describe how a simple circuit can be used to test for faulty components, and trace the circuit through components to identify breaks in the conducting loop |
| Question type: | diagnostic, simple multiple choice |
| Key words: | Bulb, battery, complete circuit |

**What does the research say?**

Building complete circuits is an idea that many students have seen earlier in their learning, but if this is their first experience of electric circuit work in a new school then unfamiliar equipment and surroundings will impair their ability to recall what they know (Solomon, 2000). Familiarisation with new equipment is an important part of this task.

When given a bulb, battery (not in holders) and a connecting wire, many 8-12 year olds, and many older students too, cannot make the bulb light up (Shipstone, 1985). These students typically treat the bulb as a *one-terminal sink* and connect the wire only one connection point. Usually the one on the end of the bulb.

Whilst most students can identify a complete circuit from a picture or a circuit diagram (Gott, 1984), this activity develops understanding of how current needs to flow *through* the components as well as through the wires, and supports the scientific model for the conservation of current.

Being able to build a circuit successfully is essential if students are to use electric circuits to develop their understanding of electricity.

**Ways to use this question**

Students should complete the question 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.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

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**

1. Not lit
2. Not lit
3. Lit
4. Lit
5. Not lit
6. Lit

**How to respond - what next?**

‘Circuits’ a, b and e all make connections to just one contact on the bulb and the battery. You cannot trace a complete circuit through the bulb. Students who believe these bulbs will light are probably not applying the idea of a complete circuit to the ‘novel’ situation of the bulb. They may be reverting to non-scientific thinking they have gained through forming lay explanations of their own experiences – e.g. a bulb fits into one end of a torch with seemingly just one connection.

In each of the other three circuits it is possible to trace the circuit from one end of the battery to a contact on the bulb, through the filament of the bulb to its other contact, and then from this contact back to the battery, and then through the battery back to the start.

When tracing circuits with students it is a good strategy not to always start at the battery. This can reinforce the misunderstanding that all the charge is stored in the battery and flows round the circuit like water through an empty pipe.

If students have misunderstandings about how the circuit is completed through a bulb, you could allow them to examine the filament of a bulb with a magnifying glass. Careful observation will show that one end of the filament appears to be connected to the tip of the bulb (although this is hard to see below a certain point) and the other end connects to the side of the bulb to the inside of the metal screw. On the tip of the bulb they can also see how the two contact points are separated with insulating material.

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

* Response activity: Light a bulb
* Response activity: Testing components

**Acknowledgments**

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Images: EPSE

**References**

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