**Broken circuit**

Slide 1



Slide 2



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

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| **Response activity** |
| **Broken circuit** |

**Overview**

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| Learning focus: | An electric circuit is a closed conducting loop containing a battery. |
| Observable learning outcome: | * Describe how a switch in a circuit affects the flow of electricity everywhere instantly. |
| Activity type: | Response, challenge to thinking, practical demonstration |
| Key words: | electric circuit, switch, component |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Switches in the circuit

**What does the research say?**

There has to be a closed loop of conducting material, from one end of the battery or power supply, through the device and back to the battery. This is a key idea about electricity that pupils have to learn, and it is important that they grasp it securely before progressing to other ideas (Shipstone, 1985).

Whilst almost all students can identify a complete circuit from a picture or a circuit diagram most have no idea of the way the various wires inside a light bulb are connected (Gott, 1984).

This activity demonstrates how current needs to flow *through* bulbs (and other components) as well as through the wires to make a complete circuit. It also shows how an interruption at any point in a circuit affects all other parts of the circuit instantly.

Both of these observations provide evidence to support the scientific model of current that students will need to develop in order to understand the more challenging aspects of electricity later on.

**Ways to use this activity**

This demonstration gives you the opportunity to explore and extend your students’ understanding through a structured teacher led discussion.

Carefully selected questions could be used to examine what the students think will happen and to encourage them to explain their reasoning. Some useful questions from slide 1 might be:

* What happens when switch 1 is opened?
* Does opening a different switch change what happens?

Use a circuit set up as shown in slide 1 to demonstrate what happens. For each switch, trace the complete (or incomplete) circuit. Start at each switch and go both ways around the circuit. (Starting at the battery every time reinforces the false idea of a sequential current.)

Ask students to suggest answers to the questions on the second slide

* What happens when bulb 1 is unscrewed?
* What happens if bulb 2 is unscrewed instead?

You might like to extend this activity using a bulb that has blown. Students could use a magnifying glass to observe the broken filament.

*Differentiation*

You could challenge different individuals by asking them follow-up questions to clarify or to extend their original answer. If a student is having difficulty with a particular question, it is often helpful to break it into smaller *chunks*, to lead them to a fuller answer. This technique models more thorough answers, and can be used to support an open classroom culture in which students are encouraged to ‘have a go’.

**Equipment**

For demonstration:

* 4.5 V battery (x3 1.5V cells)
* x2 1.5 V bulb in holder
* switch
* x6 connecting leads

**Expected answers**

Students should know that electrical devices need to be connected by wires (or other conducting material) to a power supply, and that a switch is a device that completes or breaks a circuit. They should also know that a switch anywhere in a series circuit switches everything in the circuit on and off together. They should also know that a missing or broken component anywhere in a series circuit switches everything in the circuit off together.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

**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.

Shipstone, D.M. (1985). Electricity in simple circuits. In R. Driver (Ed.), Children’s ideas in science (pp. 33-51). Milton Keynes: Open University Press.