**Bigger voltage**

Your teacher will show you this circuit. She/he will make the voltage of the battery bigger and bigger.

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| --- | --- | --- | --- | --- |
|  | 1.5V battery | 3V battery  *2 x 1.5V* | 4.5V battery  *3 x 1.5V* | 6V battery  *4 x 1.5V* |
| P**redict**  What do you think will happen to the bulb with this battery voltage? |  |  |  |  |
| **Explain**  Explain why you think this will happen |  |  |  |  |
|  | **Now observe the circuits and see what happens** | | | |
| **Observe**  Describe what happens |  |  |  |  |
| **Explain**  Were you right? Can you add to, or improve, your first explanation? |  |  |  |  |

|  |  |
| --- | --- |
| The bulb has a rating of 3V  **What will happen when the voltage is made bigger?** | 3V |

*Physics > Big idea PEM: Electricity and magnetism > Topic PEM1: Simple electric circuits > Key concept PEM1.3: Voltage*

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| --- |
| **Response activity** |
| **Bigger voltage** |

**Overview**

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| Learning focus: | Voltage is needed to push current through a component; and a particular voltage pushes just the right amount of current through a component for it to work well. |
| Observable learning outcome: | * Describe the effect of too little, or too much, voltage across a component. * Describe the voltage across a component as the strength of ‘push’ being used to get current through the component. * Use the idea of an ‘electrical push’ to explain why different components (usually) work best at a particular voltage. |
| Activity type: | Response, predict, explain, observe explain, demonstration |
| Key words: | voltage, current |

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

* Diagnostic question: Bulb markings

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING – for the first of the three observable outcomes**  This activity explores ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

The majority of students confuse ideas of voltage and current, typically they think of voltage as part of the current (Shipstone, 1985). Many students also have difficulty in applying their concepts of current [and voltage] to novel situations (Gott, 1984)

This activity gives students the opportunity to reflect on voltage as an ‘electric push’ and current as a flow of electric charge by considering how current is pushed through a bulb, and the effects that the current has on the bulb.

**Ways to use this activity**

This activity is intended as a demonstration because the aim is to ‘blow’ the bulb. The focus should be on the discussions as it is through the discussions that students can check their understanding and rehearse their explanations.

To begin, each group should discuss the activity and use their scientific understanding, firstly to predict what they think will happen, and then to explain why they think they are going to be right. If students in any group cannot agree, you may be able to direct them with some careful questioning.

Students now watch a demonstration.

After the practical each group should be given the opportunity to change, or improve their explanation. A good way to review your students’ thinking might be through a structured class discussion. You could ask several groups for their explanations and put these on the whiteboard. Then ask other groups to suggest which explanation is the most accurate and the most clearly expressed, and through careful questioning work up a clear ‘class explanation’.

A useful follow up is for individual students to then write down explanations in their own words – without reference to the class explanation on the board (i.e. cover it up).

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

*Extension*

Repeat the activity with bulbs of different voltage ratings.

**Equipment**

For the demonstration:

* 3V bulb in a holder
* x4 1.5V batteries in holders (or a lab pack)
* x5 connecting wires
* bulbs of different voltages – e.g. 1.5V, 6V, 12V

**Technician notes**

This is a demonstration as the bulbs used will be ‘blown’

**Health and safety**

**Mains electricity:** students should be reminded that wires should never be pushed into electrical sockets. It should be made clear to them that mains supply can kill.

If there are students in your class who are at risk of ignoring this advice, then it is advisable to turn off the power to the electrical sockets in your room.

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

**Expected answers**

As the voltage is increased the bulb:

* Glows dimly. The voltage cannot push enough current through the bulb. Energy is not shifting quickly enough from the moving charge to the bulb to light it up properly.
* A steady bright light at its designed voltage. The voltage is now strong enough to push enough current through the bulb to make it work properly.
* A very bright light. The current being pushed through the bulb is bigger than the bulb was designed for. Energy is shifting very quickly from the moving charge to the bulb. (The metal filament is also vaporising more quickly and shortening the life of the bulb).
* No light. The voltage pushed such a high current through the bulb that the shift in energy to the bulb was too fast and the filament melted. The whole circuit will stop working as there is now a break in it.

This is the same for all filament bulbs, although the best operating voltage will be different for each. (The best operating voltage will be determined by the length and cross-section area of the filament, and its material.)

**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.

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.