**Drawing circuits**

Making electric circuits to do a job.

Drawing accurate circuit diagrams.

**Apparatus**

* x3 1.5 V battery in holder
* x2 2.5 V bulb in holder
* x2 switches
* x6 connecting leads
* motor
* ammeter

**Procedure**

1. Build each circuit
2. For each circuit draw a circuit diagram

**Circuits to make**

1. A series circuit (a circuit with one loop) with two batteries, two bulbs and a switch.

Both bulbs turn on and off together.

1. A series circuit with two switches, one battery and one bulb.

The bulb only lights up when *both* switches are pressed.

1. A series circuit with three batteries, two bulbs and an ammeter.

The bulbs light brightly and the ammeter measures the electric current.

1. A series circuit to make a motor turn quickly.

How many batteries do you need?

1. A series circuit to measure the current in a circuit when two bulbs are lit dimly.

**Drawing circuits - review**

|  |  |  |
| --- | --- | --- |
| My success(es) | **How to draw excellent circuit diagrams.** | What I need to work on |
|  | I have used a sharp pencil. |  |
|  | I have used a ruler for every straight line in a circuit symbol. (*I even* used a ruler for the cross inside each bulb symbol). |  |
|  | All of my circuit symbols are correctly drawn. |  |
|  | I drew all the wires with a ruler. |  |
|  | There are no gaps in my circuit. Every wire exactly touches each component. The corners of my circuit exactly touch too. |  |
|  | I have drawn a large circuit diagram that fits my page. |  |

* Use this feedback to draw your best circuit diagram, of a series circuit with three bulbs.

The bulbs light very dimly when a switch is turned on.

**Drawing circuits - review**

|  |  |  |
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| My success(es) | **How to draw excellent circuit diagrams.** | What I need to work on |
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|  | I have drawn a large circuit diagram that fits my page. |  |

* Use this feedback to draw your best circuit diagram, of a series circuit with three bulbs.

The bulbs light very dimly when a switch is turned on.

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

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| **Response activity** |
| **Drawing circuits** |

**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 |
| Activity type: | response, application and practice, practical experiment |
| Key words: | electric circuit, circuit symbol, switch, buzzer, ammeter |

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

* Diagnostic question: ‘Circuit diagrams (2)’

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| **P** | **PRIOR UNDERSTANDING**  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?**

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 activity**

Students, working individually or in pairs, firstly build circuits from the instructions. Next, they draw accurate circuit diagrams of each circuit they have built. They self/peer review their drawings in order to improve their work.

The ‘Drawing circuits’ review sheet allows students to self or peer mark their work, and diagnose what they need to do to improve their circuit diagrams. The teacher will probably need to provide some guidance on the details of some success criteria. E.g. a reference for correct circuit symbols.

*Differentiation*

You could set up the circuits as a circus for the students to move around and to draw a circuit diagram of each one in turn.

**Equipment**

For each student/pair/group

* x3 1.5 V battery in holder
* x2 2.5 V bulb in holder
* x2 switches
* x6 connecting leads
* motor\*
* ammeter

\*may be shared between groups, or another component substituted

**Technician notes**

Electric circuit components and connecting wires are often faulty. It is good practice to have components checked regularly, and to have a system for collecting in damaged components as they are found.

**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**

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| --- | --- |
| 1 | 2 |
| 3 | 4 |
| 5 |  |

**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.