

# Topic: Circuits

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## **Issues tackled:**

1. Key ideas, language and terminology -Voltage, current and other key terms in electricity.
2. Misconceptions - Difficulties understanding current and what goes on in an electric circuit.
3. Practical work – Building circuits, solving problems and looking at a simulation.

## **Issue 1: Key ideas, language and terminology – Voltage, current and other key terms in electricity**

### **Prior knowledge and experience:**

### **Possible tasks:**

#### **Preparation for tutorial:**

1. Use the QCA schemes of work or the departmental scheme to find all the key words in this topic, which are either concepts or processes (e.g. voltage, not battery). Find simple definitions for each of the key words. Make a card sort of key words and meanings or a card loop game.
2. Produce a time line of the major advances in electricity.

#### **Possible activities during tutorial:**

1. Trial and evaluate card sort or loop game. Discuss where in the lesson they would use this activity (starter or plenary?). Discuss how the activity could be changed or adapted for a high or low ability group (low ability groups usually find card loop activities difficult).
2. Look at and add to the time line, discuss how this information could be shared with pupils.

### **AST Input:**

- Explain to the trainees what is meant by voltage and current.
- Provide trainees with three definitions for the same word and discuss which is best.
- Discuss the differences between concepts and processes and other activities involving key words (e.g. science taboo).
- Use furry elephant CD-ROM to explain voltage and current.
- Demonstrate the resistance of a wire (if relevant) and explain it to the trainees.

### **Reading: Subject knowledge and understanding**

Millar, R. (1989) **Understanding Physics**, Unwin Hyman, London.

Hodgson, B. (1997) **The adventures of Charlie the Coulomb**, Association for Science Education, Hatfield.

#### **Subject pedagogy**

Carlton, K. (1999) Teaching electric current and electrical potential, **Physics Education**, 34, 6, page 341.

#### **Useful websites and applications**

[www.sycd.co.uk](http://www.sycd.co.uk) - follow links to resource contents and physics, electricity.

[www.drkstreet.com](http://www.drkstreet.com) - follow links to year 7 (more) and electricity.

[www.furryelephant.com](http://www.furryelephant.com) (request free evaluation CD-ROM).

Information on using key words, particularly for SEN pupils.

[www.ase.org.uk/sen/](http://www.ase.org.uk/sen/) - follow links to SEN in the Science Department, then Supporting access and launch the .PDF file.

**Resources: Task 1**

QCA or departmental scheme of work

[www.standards.dfes.gov.uk/schemes3](http://www.standards.dfes.gov.uk/schemes3) and select Science Key Stage 3, then unit 7J.

Various key word activities

<http://wsgfl.westsussex.gov.uk> follow links to curriculum, KS3 strategy, science, curriculum resources, starters and plenary then quizzes and games.

**AST Input**

Equipment to measure the resistance of a wire (Ohm's law practical) for the tutorial

e.g. voltmeter, ammeter, 1m resistance wire (NiCr), crocodile clips, battery pack or power supply and connecting leads.

## Issue 2: Misconceptions – Difficulties understanding current and what goes on in an electric circuit

### Prior knowledge and experience:

### Possible tasks:

#### Preparation for tutorial:

1. Use internet sites (some are listed below) to find common misconceptions in electricity and make a list.
2. Work through episode 1 of the electricity section of the Supporting Physics Teaching CD-ROM. Select one of the teaching approaches suggested and plan how you would use it in a lesson.

#### Possible activities during tutorial:

1. Present the list of misconceptions. Discuss where these misconceptions come from and plan an exposition or lesson activity which will challenge 2 or more misconceptions.
2. Discuss the misconceptions, shown through the video clips on the CD-ROM and develop the planned teaching approach to overcome misconceptions.

### AST Input:

- Give examples of the difficulties pupils have in understanding electricity. For example why a complete circuit is needed, and that the current is not used up as it goes round the circuit.
- Help with planning activities which will promote a good understanding of basic circuits.
- Listen carefully while trainees practise explaining what happens to energy in a circuit, what current means and why a complete circuit is needed.

### Reading: Subject knowledge and understanding

Johnson, K. and Ryan, L. (2004) **Physics for You**, Nelson Thornes, Cheltenham or other KS4 texts with a chapter on electric circuits.

#### Subject pedagogy

Leach, J. and Scott, P. (1995) "The demands of learning science concepts – issues of theory and practice" **School Science Review**, 76, 277, page 47.

Shipstone, D. (1985) Electricity in simple circuits in Driver, R., Guesne, E and Tiberghien, A. (eds) **Children's Ideas and the Learning of Science**, Open University Press, Milton Keynes.

DiMarco, W. and Turner, T. (1998) **Learning to Teach Science in the Secondary School**, Routledge, London.

Driver, R. et al. (1994) **Making Sense of Secondary Science**, Routledge, London.

#### Useful websites and applications

[www.amasci.com](http://www.amasci.com) and look at "my electricity articles".

### Resources: Task 1

The following contains a lists of misconceptions with explanations

<http://www.eskimo.com/~billb/miscon/elect.html>

[www.iop.org/EJ/article/0031-9120/32/6/012/pe7603.pdf](http://www.iop.org/EJ/article/0031-9120/32/6/012/pe7603.pdf)

This is an article that attempts to address pupils' difficulties in basic electricity.

### Task 2

Supporting Physics Teaching 11-14. Produced by the Institute of Physics see [teachingphysics.iop.org](http://teachingphysics.iop.org)

1 set of basic circuit apparatus may be useful for planning lesson activities.

### Issue 3: Practical work – Building circuits, solving problems and looking at a simulation

#### Prior knowledge and experience:

#### Possible tasks:

##### Preparation for tutorial:

1. Use the electricity apparatus normally used in school to try out the experiments listed for this topic in the QCA or departmental scheme of work or on relevant worksheets.
2. Build simulated circuits using Crocodile Clips software. Consider the use of this package to support an exposition or for a whole class activity.

##### Possible activities during tutorial:

1. Build a few circuits from a diagram or to fulfil a task. Explain what you are doing. Example tasks are to find the effect of more cells on current or effect of resistance on current.
2. Make circuits simulations on Crocodile Clips and compare with actual circuits. Discuss the uses, advantages and disadvantages of this simulation software.

#### AST Input:

- Set up some broken circuits. Ask trainees to identify the problem and explain how to fix the circuit.
- Discuss which circuits to demonstrate and when to run a class practical.
- Discuss how to organise the practical (distribute, use/support and collect equipment). Consider the health and safety issues.

#### Reading: Subject knowledge and understanding

KS3 texts and supporting resources as used in school.

#### Subject pedagogy

Supporting Physics Teaching 11-14. Produced by the Institute of Physics see [teachingphysics.iop.org](http://teachingphysics.iop.org)

#### Useful websites and applications

#### Resources: Task 1

QCA Scheme of work

[www.standards.dfes.gov.uk/schemes3](http://www.standards.dfes.gov.uk/schemes3) and select Science Key Stage 3, then unit 7J.

Basic circuit building apparatus needed for tutorial.

#### Task 2

CD-Rom of Crocodile Clips Physics. Information and demos/downloads can be found at

[www.crocodile-clips.com](http://www.crocodile-clips.com)