# Mini-light project

KEY STAGE 1,2&3

# Mini-light project

When a designer is given a problem to solve, they often break the problem up into a number of smaller activities. This is to make sure that they do not forget any important information that might affect the design.

**Situation** – The situation will give us a general description of the background to the problem.

***Security of our personal possessions is an important part of modern life and, as a result we all carry keys with us. When you return home at night, it can often be difficult to find your lock in the dark to put your key in.***

**Design Brief** – The design brief is a summary statement that clearly states the aim of the design project and in a few words states the kind of thing that is needed. For example, 'Design a toy' is not very helpful to a designer. 'Design a toy for a baby' gives the designer a clearer focus without applying restrictions.

## Task 1

**Write a design brief for your Mini-light.**

**Investigation** – Before designing we must find out as much as we can about the situation. Investigation therefore involves collecting information from a variety of sources. When you investigate a situation, it is important for you to think about all the things that might affect your product.

## Task 2

**To help you build up a good background knowledge, investigate locks and keys using the information and activity sheets.**

**Specification** – Once you have a clear understanding of the problem, you can work out the specification for your Mini-light. A specification is a list of things that the final design must do. A good specification will list the important features in order of importance.

Specifications are an important part of designing because they provide a check list against which you can review your ideas as you are working. They also give you something against which to evaluate your ideas and your finished product.

For example, 'the toy should be painted' does not give the designer enough information. 'The toy should be painted a primary colour' is a clear statement without restricting the designer.

## Task 3

**Write a specification for your Mini-light key ring.**

- **Make a list of all the features you need to include in the design.**
- **Place them in the correct order of importance.**

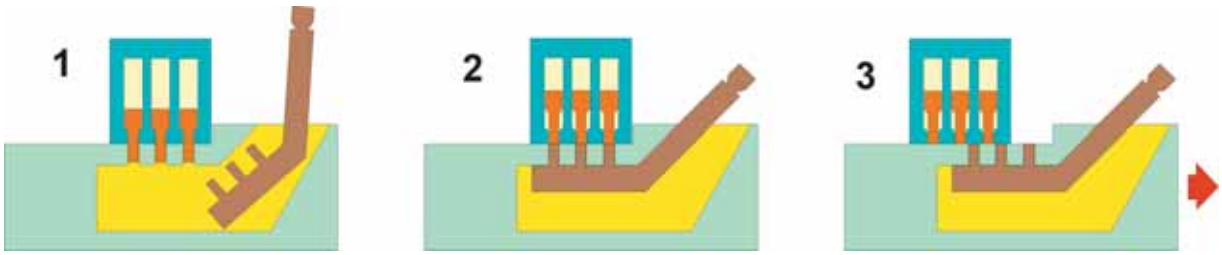
**The Design Process**

- Design Brief
- Investigation
- Specification
- Initial Ideas
- Development
- Making
- Evaluation

# Locks and keys

The earliest lock in existence is an Egyptian lock made of wood, found with its key in the ruins of Nineveh, in ancient Assyria. In construction it is the prototype of the modern cylinder lock.

## 2000 B.C. Egyptian weighted tumbler Lock




The diagram above shows an Egyptian weighted tumbler lock made over 4,000 years ago.

### How it works:

The wooden key with a series of pegs that matched the weighted pins in a lock. When the key was pushed into the hollow bolt (1.), the pins are lifted (2.), allowing the bolt to be drawn back and the lock opened (3).

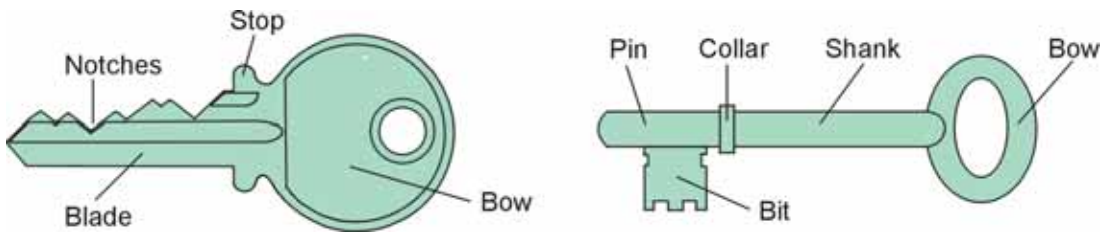
## Modern pin-tumbler lock


The diagram above shows a typical modern pin-tumbler lock

### How it works:

The key, when pushed into the keyway, lifts the tumblers by the slopes of their vee cuts. Each tumbler is in two parts, the pin and the driver. When the tumblers are lifted by the correct key, the dividing line between each pin and driver exactly coincides. The key is now free to turn and the lock will open.

## The parts of key




## Lock making in England

In England the town of Willenhall in the West Midlands has been the centre of the lock making industry since 1600. During the period 1830 to 1900 there were hundreds of small family locksmiths. Today only a few small family locksmiths remain. Locks are no longer made by hand, they are mass produced in large factories. A large proportion of these lock companies still have a base in Willenhall.

# Locks and keys activity

Keys and locks are part of our everyday life. We protect our personal belongings such as lockers and bikes by different types of keys and locks. The design of each lock and key combination has to be unique so that no other key will be able to open the lock.

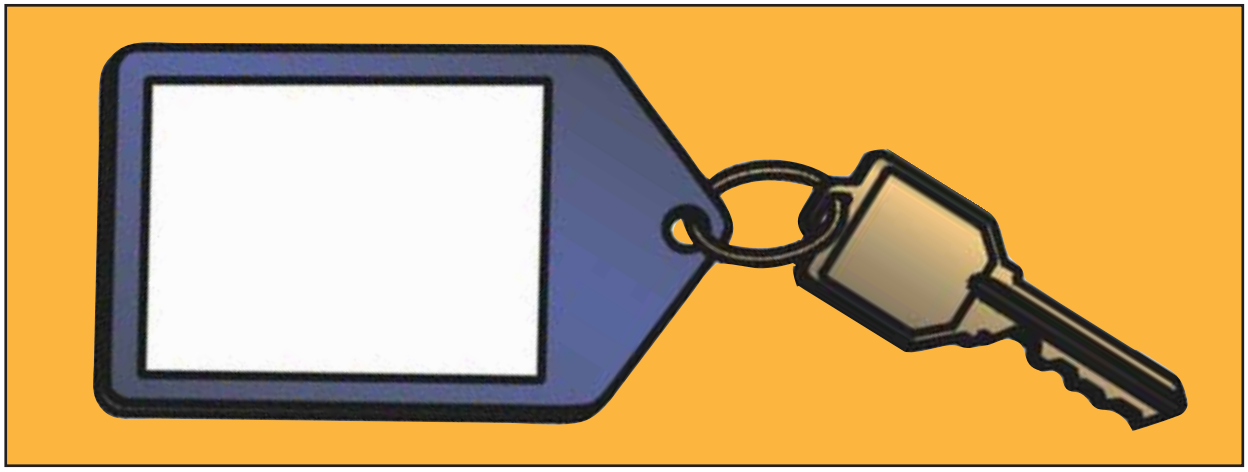
1. **Locks and keys have been in use since the early Egyptians.**
   - a) **When were the earliest locks made?**
   - b) **What materials were the early locks made from?**
   - c) **What are the notches or vee cuts in a modern key for?**
   - d) **Where is the centre for lock making in the UK?**

Designers frequently start to develop a new idea, by finding out how people use existing products, what materials they are made from and how they were made. Often designers conduct a survey to help gather information for their designs.

2. **Conduct a survey in your class into the keys people carry. You can include graphs to help explain your results. Listed below are a few points you might like to include in your survey:**
   - a) **How many keys people carry?**
   - b) **How many different types of keys do people carry?**
   - c) **What the keys are used for?**
   - d) **How much their keys weigh?**
   - e) **What else do people carry with their keys as a method of identification?**
   - f) **How are the keys kept together, what is the most common method?**

3. **Draw at least two keys and label the parts on one of your drawings. You may need to borrow some from your friends.**

4. **A new game shop called 'Puzzle' has decided to give away key fobs as part of an opening promotional event. An outline of the blank fob is drawn below.**



   - a) **Develop a series of initial ideas that contain the shop name 'Puzzle' and reflects the theme of games.**
   - b) **Select the best features from your initial ideas and draw a final design in colour on an outline of the key fob. Include both front and back designs.**

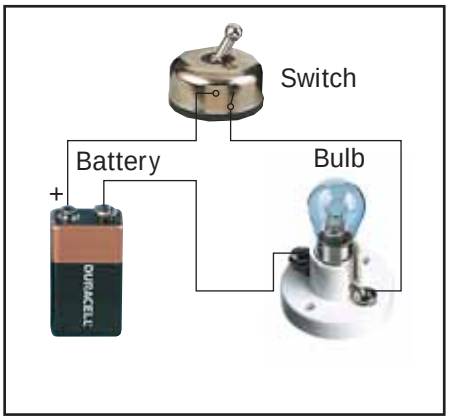
There are two sides available for artwork. Use the front for your main design. On the back include contact information, which you can make up. To make it easier to see your designs, draw your key fobs at least twice normal size.

# Circuits and symbols

A lot of devices we use, such as personal stereos, calculators and watches are powered by electricity.

For electricity to power a device, we need an electric circuit. The diagram below shows a simple circuit.

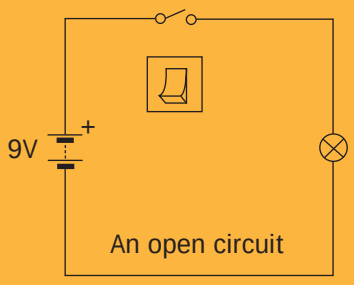
The circuit is made from a number of components: a bulb, a battery and a switch. The components are joined together with wire, which is drawn as a series of straight lines.



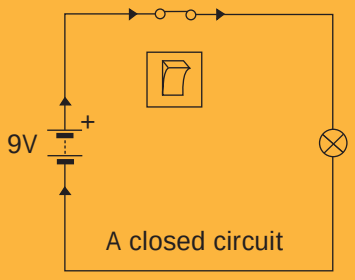

When complete the circuit provides a continuous loop around which the electricity can flow. If the circuit is broken at any stage, then the electricity will be unable to travel around the loop, with the result that the bulb will not light.

The amount of electricity flowing around a circuit is called an electric current and is measured in amperes (amps). The force that pushes the electricity around the circuit is known as an electromotive force or e.m.f. This force is measured in Volts. A battery is the normal method of providing an e.m.f. in your project work.

Even with an e.m.f., electricity will not flow through all materials. Those materials, which do not allow electricity to flow through them, are called insulators, those that do are called conductors. Copper is a good conductor and usually used for wires, rubber is a good insulator.



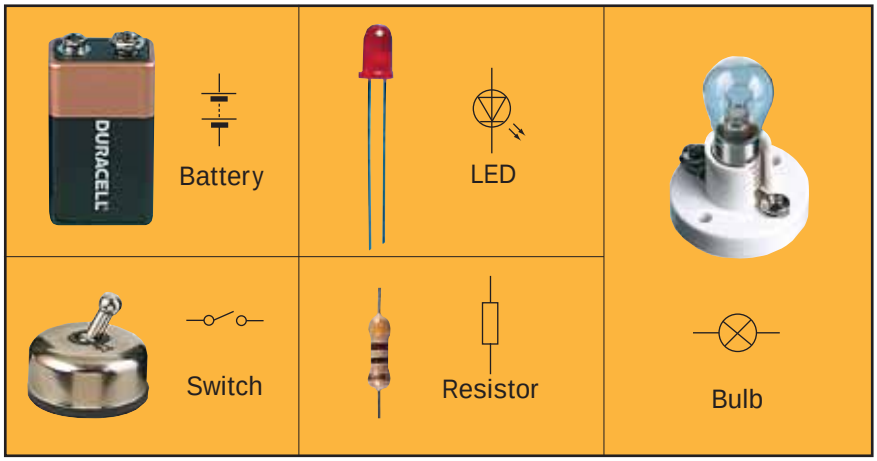

**A switch has been placed in the circuit to provide a break, which allows us to connect and disconnect the circuit when we need to. If the circuit is broken by opening the switch, the circuit will not be complete and the bulb will not light. If the switch is now closed the circuit is now complete, the electricity can travel around the circuit and the bulb will light.**




Whenever a circuit is drawn the same symbols are always used to represent the components. This is so that everyone can understand the drawing. The drawing is called a **circuit diagram**. These are a selection of the components and symbols you will use during your project work.

The symbols frequently look like the component they represent, the resistor is a good example.

The symbols may also give an indication of its use. The two arrows pointing away from the LED symbol means that it gives off light.




## Task

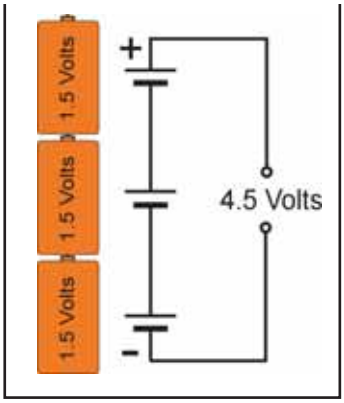
**Draw a circuit diagram for the Mini-light.**

# Batteries

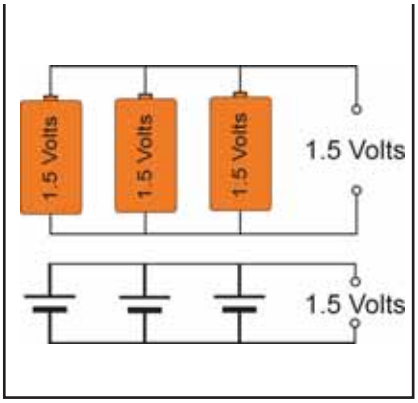
All electronic circuits need a supply of electrical energy to make them work. In projects you design and make at school, this is usually supplied from a cell or battery.

Batteries are a convenient and safe source of electrical energy. They come in a variety of sizes and have different voltage levels. It is important to select the most suitable for your design.

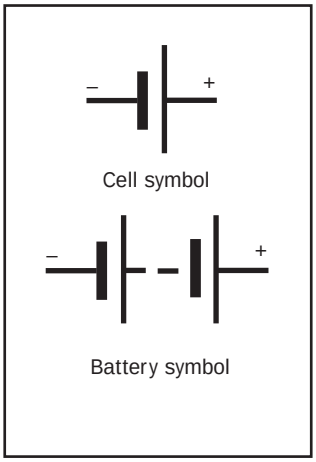
**Batteries in series**




**Batteries in parallel**








## Connecting cells

Cells can be connected in two ways. Firstly in **series**, positive to negative, to produce a greater voltage. Alternatively, the cells can be connected in **parallel**, positive to positive and negative to negative, the voltage remains 1.5 volts, but the battery will last much longer than a single cell.

| Battery | Type | V | Capacity (mAh) | Order code | Typical use | Properties |
|---|---|---|---|---|---|---|
| Zinc Chloride | AAA<br>AA<br>C<br>D<br>PP3 | 1.5<br>1.5<br>1.5<br>1.5<br>9.0 | 340<br>480<br>1800<br>3800<br>350 | **18-1440**<br>**18-1442**<br>**18-1444**<br>**18-1446**<br>**18-1448** | Calculators, portable cassette players. | Inexpensive when compared to alkaline batteries. Voltage levels not as constant in use as alkaline. |
| Alkaline | AAA<br>AA<br>C<br>D<br>PP3 | 1.5<br>1.5<br>1.5<br>1.5<br>9.0 | 1175<br>2700<br>7750<br>18000<br>550 | **18-1450**<br>**18-1452**<br>**18-1454**<br>**18-1456**<br>**18-1458** | Motors in equipment, CD players. Devices that would use a high current. | Voltage remains fairly constant throughout life. Unlikely to leak & cause great damage. Greater capacity than zinc. |
| Lithium manganese coin cells | CR2016<br>CR2025<br>CR2032<br>CR2430 | 3.0<br>3.0<br>3.0<br>3.0 | 75<br>150<br>200<br>280 | **18-0481**<br>**18-0485**<br>**18-0491**<br>**18-0375** | Memory backup power in organisers, calculators, clocks. | These batteries provide almost constant volume until discharged |
| Alkaline button cells | L621<br>L736<br>L1142 | 1.5<br>1.5<br>1.5 | 8<br>20<br>42 | **18-1395**<br>**18-0410**<br>**18-0400** | Calculators, cameras and clocks. | Ideal for small scale products. |
| Nickel Cadmium (rechargeable) | AAA<br>AA<br>C<br>D<br>PP3 | 1.25<br>1.25<br>1.25<br>1.25<br>1.25 | 250<br>500<br>1200<br>1200<br>150 | **18-1452**<br>**18-4154**<br>**18-4160**<br>**18-4164**<br>**18-4168** | Portable power tools. Safety torches. | Provide constant voltage levels when charged. Lower capacity than other batteries. |

## Selecting a battery

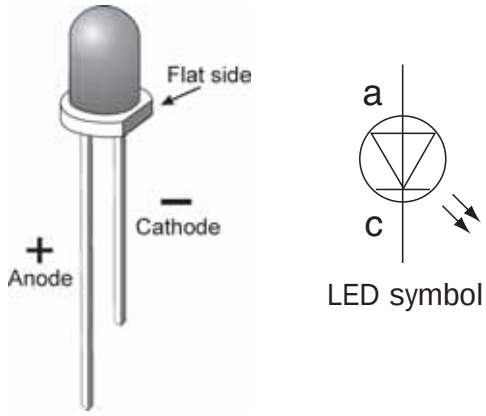
There are many different types of cells or batteries that you can use when designing your electronics project. It is important to select the most suitable type of battery for your design. The table above shows some of the more common types of cells or batteries that you can select from.

For further details and information on our full range and batteries see **www.rapidonline.com**

# Light emitting diode (LED)

A light emitting diode (LED) is a semiconductor device that gives off light when an electrical current passes through it. An LED has many advantages over a bulb. It is easier to build into your project work and less expensive. Generally they will last longer and are less fragile. However, LED's have some limitations, first the current must flow in the correct direction from positive to negative, and second the current must not be greater than 20mA or the LED can be damaged.

The symbol for an LED is shown below. LEDs have an anode (a) and a cathode (c or k). These have to be connected the correct way round or they will not light. The long leg is the anode and the short leg is the cathode. Alternatively you can identify the cathode since it is nearest the flat surface on the body of the LED.



LED symbol

**Types of LED**


LED cluster


Seven segment LED display

Bargraph LED display

## Calculations

The voltage required to light a standard red colour LED is about 1.8V ($V_F$) at a current of about 20mA, The purpose of the resistor is to limit the current to a safe value, and also to reduce the remainder of the voltage in the circuit. You will often see resistors used like this, and you need to understand how to calculate their value.

**Example**
**Based on $V_F$ = 1.8V**
**$I_F$ = 20mA**

To find the most suitable value of resistor to protect an LED we need to use Ohms law:

$$R = \frac{V_S - V_F}{I_F}$$

e.g 6V at 20mA

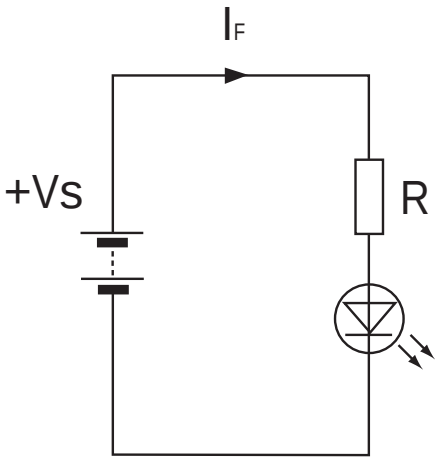
$$R = \frac{6 - 1.8}{0.02} = 210\Omega$$

The nearest standard value above this is 220R.

You should therefore use a 220R resistor in a circuit with an LED and a 6V battery.

The following are recommended values for resistors when using LEDs with other voltage supplies.

| Voltage | Value |
|---|---|
| 3V | 56R |
| 5V | 180R |
| 9V | 390R |
| 12V | 560R |




$$R = \frac{V_S - V_F}{I_F}$$

Vs = Supply
$V_F$ = Diode forward Voltdrop (1.8V)
$I_F$ = Diode forward current (20mA)

For full range of LEDs, including leading brands TruOpto and Kingbright visit **www.rapidonline.com**

# Battery and LEDs activity

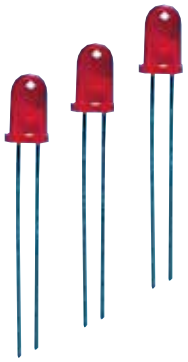
You should use the information sheet provided on the batteries and LEDs along with the Rapid Main Catalogue to help you answer the following questions. To request a catalogue phone 01206 751166.

## Batteries



1. What do the above symbols represent?
2. What type of battery would you select for the following products?
   - bicycle lamp
   - smoke alarm
   - television remote control
   - calculator
   - mobile phone
3. List the appliances you have at home that require batteries. When you get home, check which battery they are using. Use the information and notes to see if these are the right ones.

## LEDs



1. Sketch an LED and label both the anode and cathode connections.
2. Describe how the anode and cathode legs on the LED could be identified if both legs have been cut to the same length?
3. Draw the symbol for an LED.
4. Explain three advantages of using an LED instead of a bulb in your project work.
5. What will happen if an LED is not connected the correct way round in a circuit?

## Use the Rapid Main Catalogue to answer the following questions.

1. What is the Rapid order code for a 3mm 500mcd red LED?
2. How much would it cost to purchase one 3mm 500mcd red LED? How much would each LED cost if you purchased 500?
3. What is the Rapid order code for L621 button cell?
4. What is the height and diameter of the cell?
5. How much would it cost to purchase two L621? How much would you save on each cell if you purchased 100 cells?

# Initial ideas

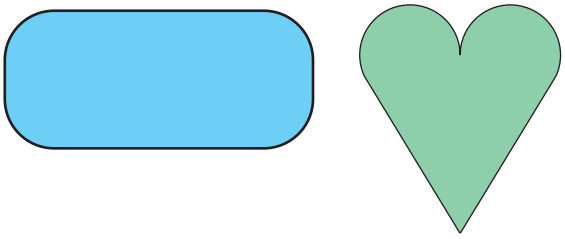
Once you have written a specification, the next stage is to draw some initial ideas. Designers try to come up with as many ideas as possible. Even if you think the idea might be a little silly, you should include it because it may be useful later.

Your specification will act as a guide for your ideas. Try to think of the main features you need to include whilst you are drawing.

## Task

**In the space below draw as many different ideas as possible.**
**Try to think of alternative themes for your design ideas.**
**Two examples have been drawn to help you start.**
**Include some notes to help explain your designs.**

*Do not make your designs too complicated with lots of small cut and turns. This will prove difficult for you to cut out.*



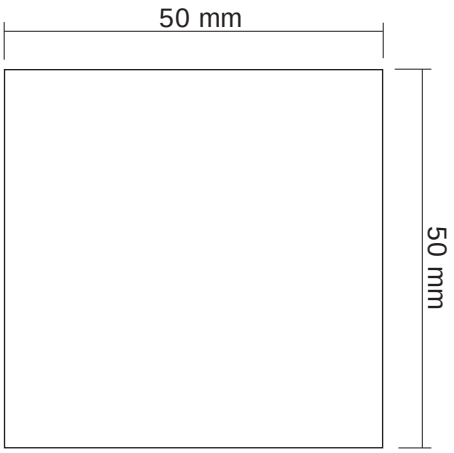
# Development

To develop an idea or series of ideas, we need to start thinking about manufacturing the design. Will you be able to manufacture the design? How will the initial idea need to be changed so that it can be manufactured from the materials available and with the workshop facilities available?

## Task

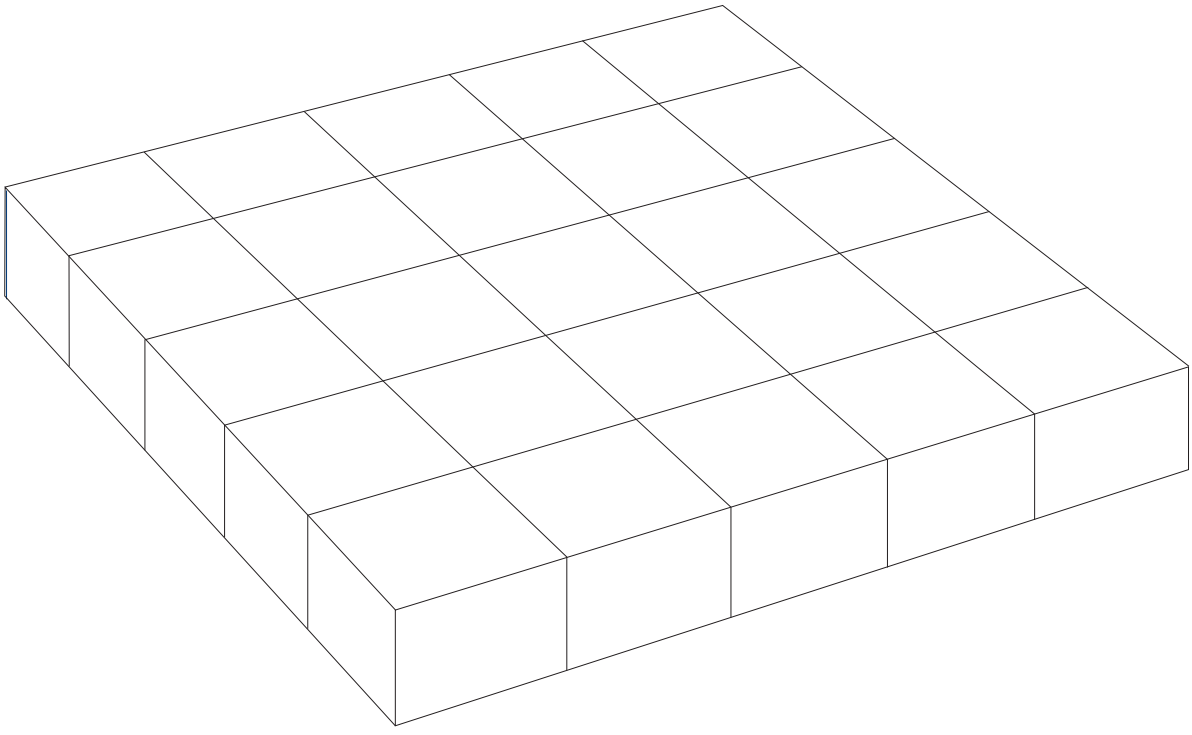
**Develop a final design. Draw a 2D drawing to scale in the box provided. Indicate where the battery is to be placed and where the LED is located.**

**Final Design**



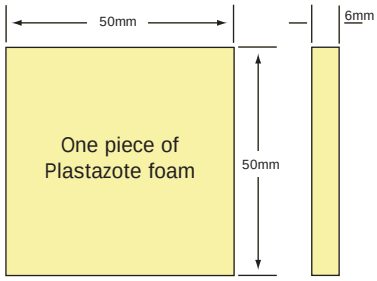

## Task

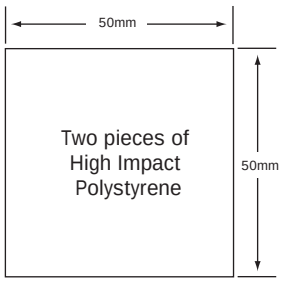
**Draw a 3D picture of your final design. Take care to shade the design using coloured pencils. The faint grid will help you get the correct perspective.**



# Procedure for manufacture

1. Collect together the following material and components to make your Mini-light:




| | | |
|---|---|---|
| **Red LED kit** | 2x L621 button cells | 1x Red 3mm LED (56-0530) |
| **White LED kit** | 3x L621 button cells | 1x White 5mm LED (55-2216) |
| **Rainbow LED kit** | 3x L621 button cells | 1x Rainbow 5mm LED (55-1904) |
| **UV LED kit** | 3x L621 button cells | 1x UV 3mm LED (55-1836) |

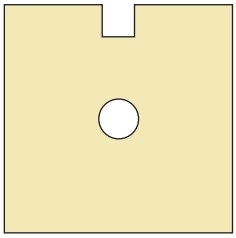
2. Using double sided tape, stick the two outer pieces of plastic (High Impact Polystyrene) together.

3. Attach your template on the two pieces of outer plastic. Make sure that you make good use of the material available.

4. Cut around you template, ensuring that you take care to cut on the waste side.

5. Use fine abrasive paper to smooth the outer plastic to the final shape of your template.

6. Cut slot for LED to fit in.



7. Place cells and LED in place in the foam.

8. Using double sided tape, attach one of the outer pieces of plastic to the foam. Take care to ensure that it is in the correct position.

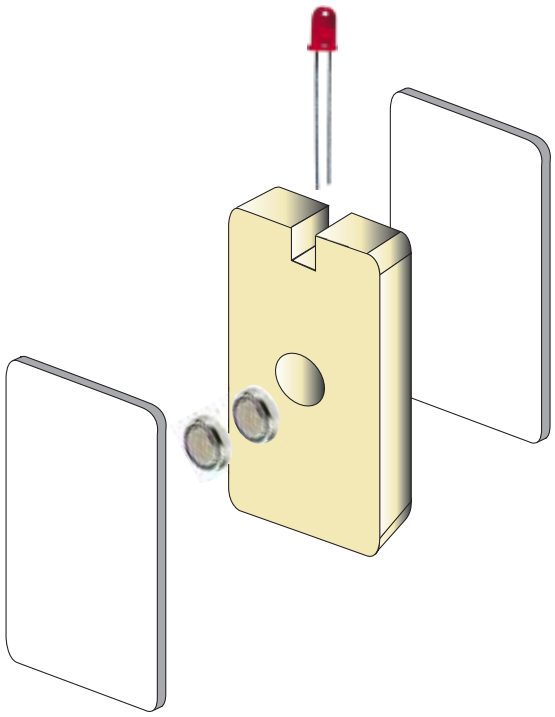
9. Cut the foam roughly to the shape of the outer plastic.

10. Attach the other piece of outer plastic, taking care to align it.

11. Use glass paper to finish the Mini-light final shape. Take great care not to damage the LED.

12. Drill hole for split ring to pass through. You will need to be careful not to squeeze the foam too much or you might damage the electronic components inside.

13. Remove protective film covering outer plastic and fit split ring to Mini-light.



**Make sure that the LED and the batteries are connected the correct way around before you assemble the Mini-light.**

**Ask your teacher for help if you are unsure.**

# Procedure chart

**Task**

**Draw a procedure chart, using a series of pictures to describe how you have manufactured your Mini-light. Make sure that your diagrams show the important detail.**

# Packaging activity

Packaging is the description we give to a wide range of containers that are used for holding consumer's products. Packages are designed to describe or show the product. They are also designed to attract attention by use of graphic images that make us want to buy them.

## Identity

A company will take great care in building an identity. They often use a symbol or logo on their products. The logo has to stand out and be easily remembered by a customer. A company will also use a slogan, a colour scheme, or a style of lettering to help reinforce their identity. The Rapid logo is a good example. The horizontal blue bars give the impression of movement and speed.

### Task

**Develop a corporate image for your company to manufacture the Mini-light.**
**You will need to think about the following elements:**
- **Company name**
- **Symbol**
- **Slogan**
- **Lettering style**

**Draw some ideas and test out different lettering styles for:**
- **Your company name**
- **The name of product 'Mini-light'**

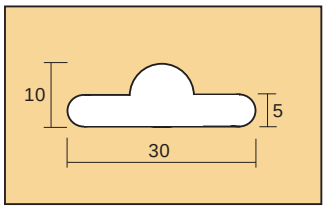

You can use a computer to help you experiment with lettering styles. Your final corporate image should be a combination of all the best elements.

## Display

There are many different methods for displaying a product for sale in a shop. One of the most popular is to display the product mounted on card. This makes it easier for the customer to select. This style of packaging is called suspension packaging and is used for a wide variety of products.
An essential feature of suspension packaging is the ***supporting card***. The graphics on the card need to be designed with great care if it is to sell the product successfully.

### Task

**Design a supporting card for your Mini-light.**




If your support card is going to be effective, the layout images and colour scheme need to be designed with care. You should consider the following:
- That the graphics and written information are not obscured when the product is placed on the card.
- Your design for the supporting card should fit onto an A5 piece of card.
- Support card slots are all made to the same size shown above. It is important that you include space in these for your design.

## Attachment

It is clearly important to ensure that your Mini-light is secured firmly to the suspension card.
If it is not secure, the Mini-light might well get damaged. Your Mini-light can be held on the support card in a variety of ways.
- The simplest method is by attaching the product to the supporting card by placing a small piece of string through the key ring and attaching this to the supporting card through two holes.
- The Mini-light could be secured on the supporting card by using a non-destructive sticky pad.
- A secure method of attaching the Mini-light to the supporting card would be to cover it with a vacuum formed plastic shell. This will allow the customer to clearly see the Mini-light whilst protecting it.

### Task

**Design a method of attaching your Mini-light to the suspension card.**
**The Mini-light must be held securely and where possible protected from damage.**

# Evaluation

Evaluation is an important part of the design process. It is used by designers to check they have produced a good design with all the features they identified in the specification. When you are evaluating a product you are trying to find out both its good and poor features.

Your own opinions are important, but you must also get some other peoples opinions as well. They may notice qualities you cannot see.

## Task

**Evaluate your Mini-light project by establishing if it meets your specification. Look at your specification and write down in the boxes below two features against which you can judge the quality of your Mini-light.**

**1.**

**2.**

## Task

**Show in a series of sketches how your final Mini-light design could be improved.**

# Progress diary

Each week, write a short paragraph about the work you have done. As well as commenting on good aspects of the lesson, try to comment on work that has not gone so well, or that you did not fully understand.

When designing, it is also important to think ahead. Write down in the second section what work you anticipate doing next week on your project.

| | |
|---|---|
| **Week 1** | Today _____ |
| | Next Lesson |

| | |
|---|---|
| **Week 2** | Today _____ |
| | Next Lesson |

| | |
|---|---|
| **Week 3** | Today _____ |
| | Next Lesson |

| | |
|---|---|
| **Week 4** | Today _____ |
| | Next Lesson |

| | |
|---|---|
| **Week 5** | Today _____ |
| | Next Lesson |

| | |
|---|---|
| **Week 6** | Today _____ |
| | Final comment: |

**Teacher comments:**

# Word search

Hidden in the box of letters are new words that you have learnt that are connected with electronics. Circle the word when you have found it and write the word down in the space next to the question. The first example has been done for you. Use the information sheets to help you find the words:

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K | T | C | V | I | O | S | E | R | E | S | I | S | T | O | R | Y | C | E | S |
| I | S | E | R | I | E | S | Z | L | T | O | V | X | R | E | E | P | J | I | Y |
| S | P | R | R | E | S | I | S | T | O | S | I | K | B | D | F | A | O | C | M |
| L | T | C | A | N | O | D | E | L | H | F | N | J | M | O | Q | R | R | R | B |
| E | C | U | T | E | W | Z | L | E | T | I | S | R | A | F | R | A | H | C | O |
| D | W | I | C | A | T | H | O | D | E | X | U | L | Y | G | J | L | X | E | L |
| V | A | T | Y | T | L | W | Z | R | H | T | L | E | C | V | O | L | T | S | G |
| T | S | W | I | T | C | H | R | S | A | R | A | U | H | E | C | E | N | E | R |
| Z | A | C | F | I | S | Y | V | O | S | D | T | O | M | S | T | L | R | S | V |
| J | I | T | G | C | O | N | D | U | C | T | O | R | Q | T | R | P | T | U | X |
| M | K | W | L | I | D | V | O | T | V | L | R | Q | S | C | O | P | P | E | R |
| T | B | A | T | T | E | R | Y | G | B | N | J | C | F | N | N | E | P | K | L |
| A | C | Y | T | Y | P | D | E | P | D | A | F | G | S | Q | K | A | M | P | S |

## Questions

The metal most commonly used for electrical wires. *C o p p e r*

A diode that gives off light. _____

A device that provides an e.m.f. _____

A material which will allow electricity to flow through it. _____

A material which does not allow electricity to flow through it. _____

A device to break an electric circuit. _____

A way of connecting batteries together to provide a higher voltage. _____

The name given to the positive leg of an LED. _____

A way of connecting batteries together to provide more current. _____

The name of the negative leg of an LED. _____

The units we use to measure an e.m.f. _____

The units we use to measure an electric current. _____

A component used to protect an LED in a circuit. _____

A sign used to represent a component in a circuit diagram. _____

# Mini-light project

# Teacher notes

## Introduction

Rapid have developed the Mini-light project in response to teacher's requests for new electronics based project work. The Mini-light project provides teachers with a cost-effective means of introducing students in early Key Stage 3 to 'design and make' in electronics. Emphasis has been placed on using new components and materials, whilst producing a quality product of which students can be proud.

A key feature of the teaching material is that in addition to providing a student resource, it also contains detailed teacher support notes for guidance. The teaching pack has been designed to be photocopied. A number of the activity sheets can be used in isolation from the project. Included in the material are a series of structured homework assignments to support the work in class.

A suggested project plan has been included based on teacher experience. However, the detailed project organisation will depend upon timetable, facilities and student needs.

The project is intended for use with mixed ability year 7 students. The practical work should be possible in a typical secondary based workshop. However, with careful organisation it is possible to manufacture the design without specialist workshop facilities.

## Aims and objectives

The project is to design and make a Mini-light that can be attached to a key ring. The project will enable students to experience the design and manufacture of simple electronic circuits.

**Concepts:**

- Electronic circuits.
- Design and manufacture.
- Product marketing.
- Evaluation.

**Objectives:**

Pupils should understand:

- The need to investigate the background to a problem.
- How to select appropriate components to build simple electronic circuits.
- The importance of planned manufacture.
- The need for effective marketing for the promotion of a product.
- How to improve a product by evaluation.

**Science opportunities:**

- Understanding of circuit theory.
- Variety of power supplies and how they can be combined.

**Maths opportunities:**

- Costing material used in production of design.
- Accurate measurement and marking out.

**IT opportunities:**

- Use of Crocodile Clips to develop and test circuit ideas.
- Graphic packages can be used to help generate ideas and with the production of support card packaging.
- Spreadsheets allow for analysis of investigation material and cost of production.

**Other opportunities:**

- Develop an understanding of how products are marketed
- The importance of company identity.

# Project plan

## Week 1 - Introduction and investigations

**Aim:**

- Introduce problem and discuss background.
- Analyse examples of alternative products.
- Write design brief.
- Investigate locks and keys to build background knowledge.

**Teaching input:**

- Lead discussion on background to problem.
- Assist in the writing of the design brief and specification.
- Advise on organisation of information gained from locks and keys activity sheets.

**Demonstrations:**

- Examine existing solutions (torches and other key based lights) looking at advantages and disadvantages.
- Locks and keys.

**Pupil activity:**

- Write design brief.
- Investigate lock and keys.

**Resources:**

- Examples of existing solutions.
- Example of a Mini-light.
- 'Mini-light project' sheet.
- 'Locks and keys' information and activity sheets.
- Examples of locks and keys.

**Homework:**

- Present findings from research from locks and keys activity sheet.
- Selected questions from locks and keys activity sheet.
- Diary record.

## Week 2 - Components and circuits

**Aim:**

- Develop concept and knowledge of simple electronics circuits.
- Recognition and selection of components.
- Experiment with building electronic circuits.

**Teaching input:**

- Lead discussion on circuits and symbols.
- Guidance on building and testing circuits.
- Assistance with work on batteries and LEDs.

**Demonstrations:**

- Construction of circuits.
- Variety of cells, batteries and LEDs. Their use in everyday products.

**Pupil activity:**

- Testing variety of electronics circuits.
- Questions based on activity sheets.

**Resources:**

- 'Circuits and symbols' activity sheet.
- 'Batteries' activity sheet.
- 'LED' activity sheet.
- Electronic components for testing, multimeters, power supplies.

**Homework:**

- Selected questions from activity sheets on batteries and LEDs.
- Diary record.

# Project plan

## Week 3 - Design ideas

**Aim:**
- Establish specification.
- Generate initial ideas and develop final solution.
- Develop graphical communication and presentation skills.

**Teaching input:**
- Lead discussion on specification.
- Guide students through generation and development of ideas.
- Advice on presentation techniques and layout of work.

**Demonstrations:**
- Graphical presentation based on coloured pencil work.

**Pupil activity:**
- Write specification.
- Draw range of initial ideas.
- Develop chosen idea and present final solution.

**Resources:**
- "Initial ideas" activity sheet
- "Development" activity sheet
- Coloured pencils and associated drawing materials.

**Homework:**
- Completion of unfinished design work.
- Preparation of template for practical work next lesson.
- Diary record.

## Week 4 - Manufacturing Design

**Aim:**
- Review of safe working practices in the workshop.
- Students to start manufacturing Mini-light designs.

**Teaching input:**
- Review safety in the workshop.
- Provide assistance to students to start manufacturing Mini-light designs.
- Assist students with any changes needed in design prior to manufacture.

**Demonstrations:**
- Demonstrate methods and tools for manufacture.

**Pupil activity:**
- Manufacture Mini-light.

**Resources:**
- Per student: Two button cells (order code **18-1395**).
  One Ultrabright 3mm LED (order code **56-0530**).
  Two pieces of 1.5mm High Impact Polystyrene, 50mm square.
  On piece of 6mm Plasazote foam 50mm square.
- Double sided tape.
- Workshop tools.

**Homework:**
- Procedure chart for manufacture.
- Diary record.

# Project plan

## Week 5 - Packaging

**Aim:**
- Complete manufacturing of any unfinished Mini-lights.
- Design and manufacture sales package for Mini-light.

**Teaching input:**
- Provide support to help students finish the construction of their Mini-light.
- Lead discussion into the types and styles of packaging suitable for the Mini-light.
- Assist students in the development of presentational techniques.

**Demonstrations:**
- Methods of manufacture for selected packaging styles e.g. vacuum forming.
- Presentation techniques.

**Pupil activity:**
- Complete any unfinished construction of Mini-light.
- Develop corporate image designs.
- Design supporting card and method of attachment.

**Resources:**
- Examples of advertising and packaging.
- Vacuum forming machine, suitable moulds.
- Card blanks and drawing equipment to produce supporting cards.

**Homework:**
- Packaging questions at the end of the 'Packaging' activity sheet.
- Diary record.

## Week 6 - Evaluation

**Aim:**
- Completion of packaging.
- Evaluation of Mini-light and student progress.

**Teaching input:**
- Lead discussion on important feature to include in project evaluations.

**Demonstrations:**
- Evaluation of alternative products as a contrast to student own work.

**Pupil activity:**
- Completion of packaging Mini-light.
- Evaluation against specification.
- Design improvements.

**Resources:**
- Vacuum forming machine, suitable moulds.
- Card blanks and drawing equipment to produce supporting cards.
- Selection of similar products for evaluation discussion.

**Homework:**
- Diary record.

# National Curriculum 2000

## Design & Technology
## Programme of Study Key Stage 3

During Key Stage 3 pupils use a wide range of materials to design and make products. They work out their ideas with some precision, taking into account how products will be used, who will use them, how much they cost and their appearance. They develop their understanding of 'designing and making' by investigating products and finding out about the work of professional designers and manufacturing industry. They use computers, including computer-aided design and manufacture (CAD/CAM) and control software, as an integral part of designing and making. They draw on knowledge and understanding from other areas of the curriculum.

## Knowledge, skills and understanding

Developing, planning and communicating ideas

1. Pupils should be taught to:
   a. identify relevant sources of information, using a range of resources including ICT;
   b. respond to design briefs and produce their own design specifications for products;
   c. develop criteria for their designs to guide their thinking and to form a basis for evaluation;
   d. generate design proposals that match the criteria;
   e. consider aesthetics and other issues that influence their planning;
   f. suggest outline plans for designing and making, and change them if necessary;
   g. prioritise actions and reconcile decisions as a project develops, taking into account the use of time; and costs when selecting materials, components, tools, equipment and production methods;
   h. use graphic techniques and ICT, including computer-aided design (CAD), to explore, develop, model and communicate design proposals.

Working with tools, equipment, materials and components to produce quality products

2. Pupils should be taught:
   a. to select and use tools, equipment and processes, including computer-aided design and manufacture (CAD/CAM), to shape and form materials safely and accurately and finish them appropriately;
   b. to take account of the working characteristics and properties of materials and components when deciding how and when to use them;
   c. to join and combine materials and ready-made components accurately to achieve functional results;
   d. to make single products and products in quantity, using a range of techniques, including CAD/CAM to ensure consistency and accuracy;
   e. about the working characteristics and applications of a range of modern materials, including smart materials.

Evaluating processes and products

3. Pupils should be taught to:
   a. evaluate their design ideas as these develop, and modify their proposals to ensure that their product meets the design specification;
   b. test how well their products work, then evaluate them;
   c. identify and use criteria to judge the quality of other people's products, including the extent to which they meet a clear need, their fitness for purpose, whether resources have been used appropriately, and their impact beyond the purpose for which they were designed.

**Knowledge and understanding of materials and components**

4. Pupils should be taught:
   a. to consider physical and chemical properties and working characteristics of a range of common and modern materials;
   b. that materials and components can be classified according to their properties and working characteristics;
   c. that materials and components can be combined, processed and finished to create more useful properties and particular aesthetic effects;
   d. how multiple copies can be made of the same product.

**Knowledge and understanding of systems and control**

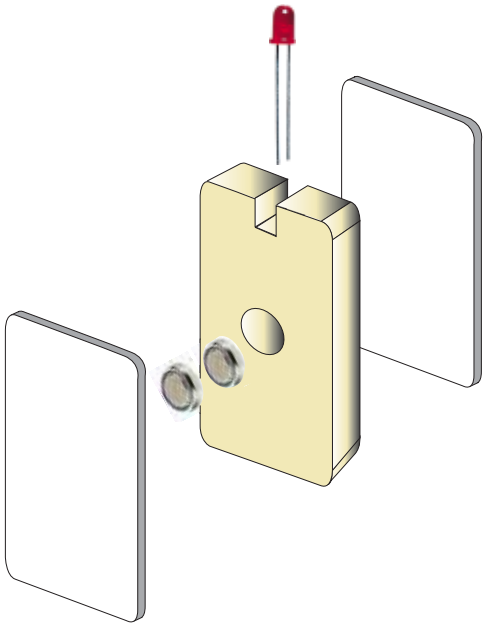
5. Pupils should be taught:
   a. to recognise inputs, processes and outputs in their own and existing products;
   b. that complex systems can be broken down into sub-systems to make it easier to analyse them, and that each sub-system also has inputs, processes and outputs;
   c. the importance of feedback in control systems;
   d. about mechanical, electrical, electronic and pneumatic control systems, including the use of switches in electrical systems, sensors in electronic switching circuits, and how mechanical systems can be joined together to create different kinds of movement;
   e. how different types of systems and sub-systems can be interconnected to achieve a particular function;
   f. how to use electronics, microprocessors and computers to control systems, including the use of feedback;
   g. how to use ICT to design sub-systems and systems.

**Knowledge and understanding of structures**

6. Pupils should be taught:
   a. to recognise and use structures and how to support and reinforce them;
   b. simple tests and appropriate calculations to work out the effect of loads;
   c. that forces of compression, tension, torsion and shear produce different effects.

**Breadth of study**

7. During the key stage, pupils should be taught the knowledge, skills and understanding through:
   a. product analysis;
   b. focused practical tasks that develop a range of techniques, skills, processes and knowledge;
   c. design and make assignments in different contexts. The assignments should include control systems, and work using a range of contrasting materials, including resistant materials, compliant materials and/or food.



# Word search

## Teacher master

K T C V I O S E R E S I S T O R Y C E S
I S E R I E S Z L T O V X R E E P J I Y
S P R R E S I S T O S I K B D F A O C M
L T C A N O D E L H F N J M O Q R R R B
E C U T E W Z L E T I S R A F R A H C O
D W I C A T H O D E X U L Y G J L X E L
V A T Y T L W Z R H T L E C V O L T S G
T S W I T C H R S A R A U H E C E N E R
Z A C F I S Y V O S D T O M S T L R S V
J I T G C O N D U C T O R Q T R P T U X
M K W L I D V O T V L R Q S C O P P E R
T B A T T E R Y G B N J C F N N E P K L
A C Y T Y P D E P D A F G S Q K A M P S

## Questions

The metal most commonly used for electrical wires.

A diode that gives off light.

A device that provides an e.m.f.

A material which will allow electricity to flow through it.

A material which does not allow electricity to flow through it.

A device to break an electric circuit.

A way of connecting batteries together to provide a higher voltage.

The name given to the positive leg of an LED.

A way of connecting batteries together to provide more current.

The name of the negative leg of an LED.

The units we use to measure an e.m.f.

The units we use to measure an electric current

A component used to protect an LED in a circuit.

A sign used to represent a component in a circuit diagram.

**Copper**
**LED**
**Battery**
**Conductor**
**Insulator**
**Switch**
**Series**
**Anode**
**Parallel**
**Cathode**
**Volts**
**Amps**
**Resistor**
**Symbol**