



Theme - **Electricity**

Contents

	Page
1. Introduction	2
2. Supporting Information	3
2.1 How to use this pack	3
2.2 Electricity in the primary science curriculum	4
2.3 Background information on electricity	6
2.4 Equipment for electricity	6
2.5 Simple circuits	7
2.6 Electrical safety	8
2.7 Glossary of electrical terms	8
3. Sample lesson plans	10
3.1 Infants	10
3.2 First and second classes	12
3.3 Third and fourth classes	14
3.4 Fifth and sixth classes	16
4. Follow-up activities	18
5. References	21
6. Evaluation form	22



1. Introduction

Primary Science Day is an initiative of the Science Technology and Innovation Awareness Programme. It is supported by the Department of Education and Science and the INTO. It is a day when primary schools are invited to spend some time on science. This year Primary Science Day is on 3rd December 2002 and electricity is the theme.

Schools are asked to do a science lesson on the day. Each school will receive a pack with a sample lesson for each class level and some equipment to do the lessons. The pack includes background information and suggests follow-up activities and references to support teachers. The lessons are based on the SESE: Science curriculum. This initiative supports the work of the Primary Curriculum Support Programme of the Department of Education and Science.

Last year, 2001, all primary schools received a pack with a teacher's booklet and colourful magnets for use with all the classes. On Primary Science Day the response was marvellous. Children throughout the country used the magnets and explored magnetism. In their evaluations the schools suggested the theme of electricity for this year.



2. Supporting information

2.1 How to use this pack

Each school receives a pack that consists of:

- A teacher's booklet
- Electrical equipment for use with the senior primary classes.

The booklet contains information on electricity in the curriculum, background information on electricity and equipment for electricity; sample lesson plans for one lesson at each class level and follow-up activities on the topic of electricity. Each lesson takes about 40 minutes.

The lessons are starting points for the children's investigation of electricity. They have been developed from some of the exemplars in *Approaches to learning about electricity and magnetism* in the SESE: Science Teacher Guidelines pp 96-106.

Using the pack

The following are some suggestions for using this pack:

- copy the booklet for each member of staff
- decide which classes will undertake the activities. Some of the activities developed for the junior classes may be useful as an introduction to electricity for the senior classes.
- copy the Teacher's Notes and Worksheets for the classes
- before undertaking the work in class check the equipment and the activities. See section 2.4 for further details.
- timetable the materials on the chosen day
- review the activities and fill in the evaluation form. The children's work could be displayed in their classrooms or throughout the school.
- send the evaluation form to Forfás.

Any classes that cannot use the pack on the suggested day could use it at another time. The pack is for use on Primary Science Day and is also a permanent resource for schools.



2.2 Electricity in the primary science curriculum

Science in the primary curriculum aims to introduce children (from infants to Sixth class) to the wonder of science, to develop a lasting interest in science and to provide opportunities for children to work scientifically. Learning science should stimulate curiosity and be fun. The curriculum for science aims to develop children's skills and their understanding of science concepts. There are four content strands: Living things, Energy and forces, Materials and Environmental awareness and care. Children are encouraged to develop the skills of working scientifically and designing and making. The approach to science is to start from the children's ideas and to work in an active and collaborative way to investigate the world in which we live.

Electricity in the curriculum

Children live with electricity every day. It is a source of light and heat; it is used at home and at school. Electricity is part of the *Magnetism and electricity* strand unit in Energy and forces (see pages 26, 44, 64 and 86 SESE: Science Curriculum). In infant classes children are encouraged to become aware of electricity and how it is used at home and at school. As they become older children explore the effects of static electricity. Then in third and fourth classes children start to investigate simple circuits. Terms such as circuits, conductors and insulators begin to be used. In the older classes children learn about electrical energy and become aware of how some common electrical appliances work. Electricity provides many opportunities for designing and making, particularly in the middle and senior classes. Children can make switches, games and other artefacts incorporating simple circuits. This is great fun. At each class level children should become aware of the dangers of electricity and how to use it safely.

The SESE: Science Teacher Guidelines suggest how to approach learning about electricity and magnetism on page 96 (as Gaeilge leathanach 114). Exemplar 5 on page 43 (as Gaeilge leathanach 45) illustrates how a unit of work on electricity can be developed with children in senior classes. There are exemplars on static electricity (first and second classes), making a circuit (third and fourth classes) and conductors and insulators from page 99 (as Gaeilge leathanach 103). The lessons in the pack are based on these exemplars.



Electricity and other areas of the curriculum

Electricity affects much of our daily life and plays an important part in a child's life. The diagram shows some ways electricity might be integrated with other areas of the curriculum.

Geography

People using electricity

- finding where electricity is made (generated)
- finding out how electricity gets to our homes
- using electricity wisely

History

Exploring the past

- cooking food without electricity
- lighting our homes
- find out the history of the lightning conductor

ICT

- researching electricity in Ireland
www.esb.ie
- presenting work on electricity

electricity

Language

- reading instruction booklets for electrical appliances e.g. mobile phone chargers, play stations
- use electrical terms e.g. socket, plug, wire, fuse, battery at the appropriate level
- talking about electrical safety

SPHE

Safety issues

- playing safely at home
- using the toaster safely
- what to do when a light bulb needs changing
- electrical safety at home, in school and outdoors



2.3 Background information on electricity

Electricity is used to make many devices work. Electricity flows in a pathway called a circuit. A complete circuit is needed to make electrical devices work. A battery is needed in a circuit. It provides the energy that pushes the electricity around the circuit. Electricity does not flow if there is a broken circuit or pathway. Electricity flows through conductors (mainly metals) and does not flow through insulators (plastic and other materials).

2.4 Equipment for electrical circuits

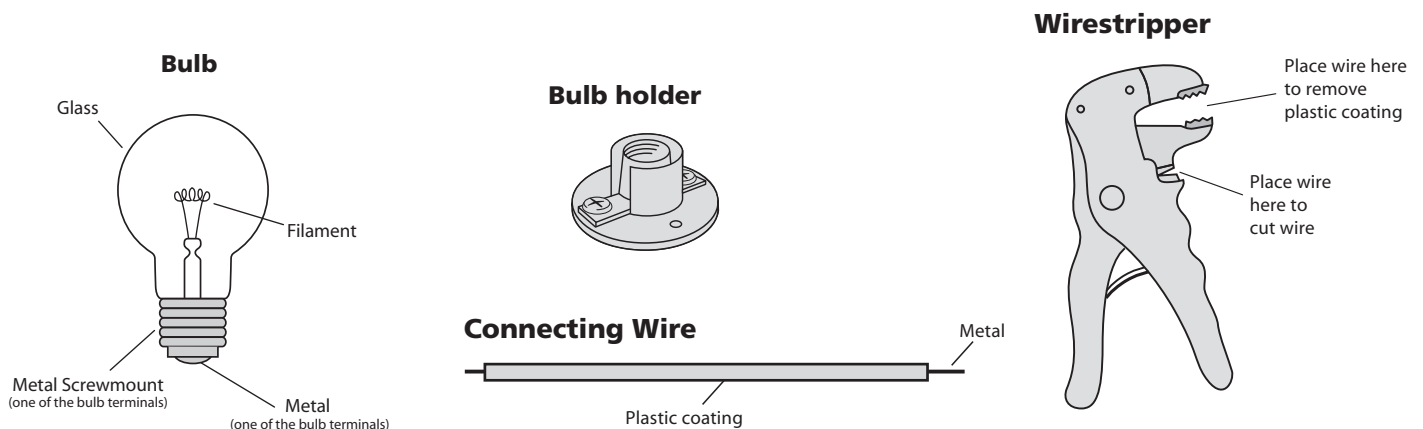
The basic equipment needed for simple circuits is batteries, wires and bulbs.

The equipment in the pack will be sufficient for a class of 30 children working in groups of three. The pack contains:

- 10 batteries (size C)
- 10 battery holders (size C)
- 40 bulbs (1.5 V MES)
- 20 bulbholders (MES)
- 5 screwdrivers
- 1 automatic wire strippers
- 20 m of wire (cable)

The size C 1.5 V batteries match the battery holders supplied. The wire needs to be prepared for the lessons. Use the automatic wire strippers to cut the wire into suitable lengths (around 20 - 25 cm) and then strip about 1 cm of the plastic off each end of the wire. The wire is then ready to use in class. Prepare as much wire as you can, this will give the children extra wires for experimentation. The 1.5 V bulb is used with one battery. The bulb holder is very useful and sturdy. The wires are connected to the holder at the screws by simply touching, sticking them with sticky tape or using a screwdriver.

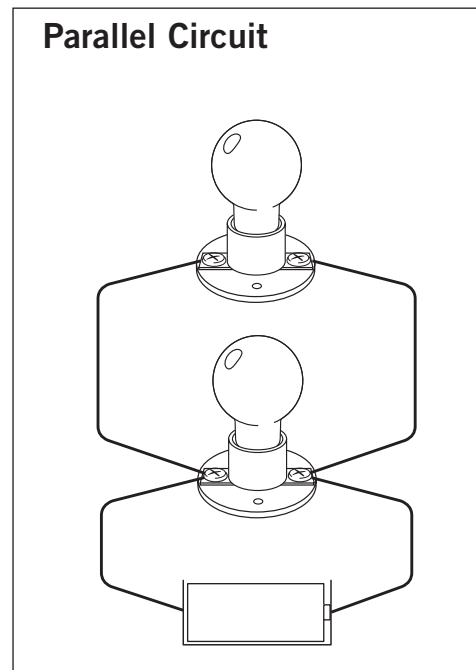
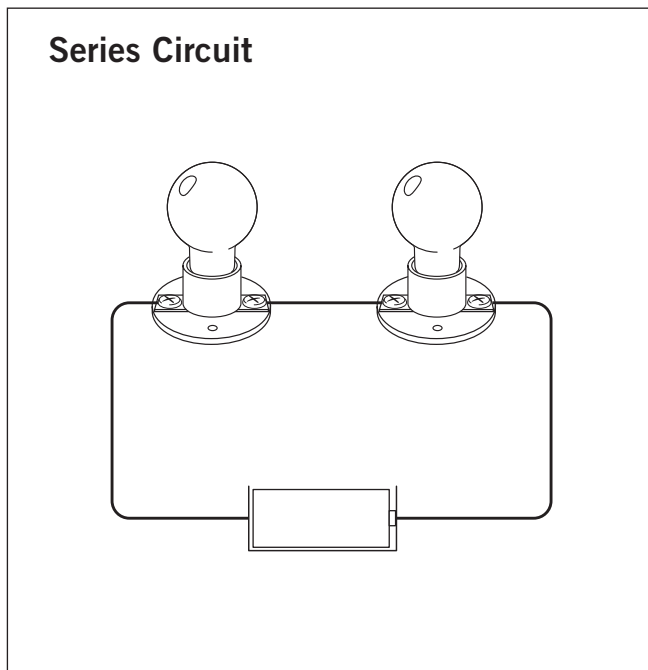
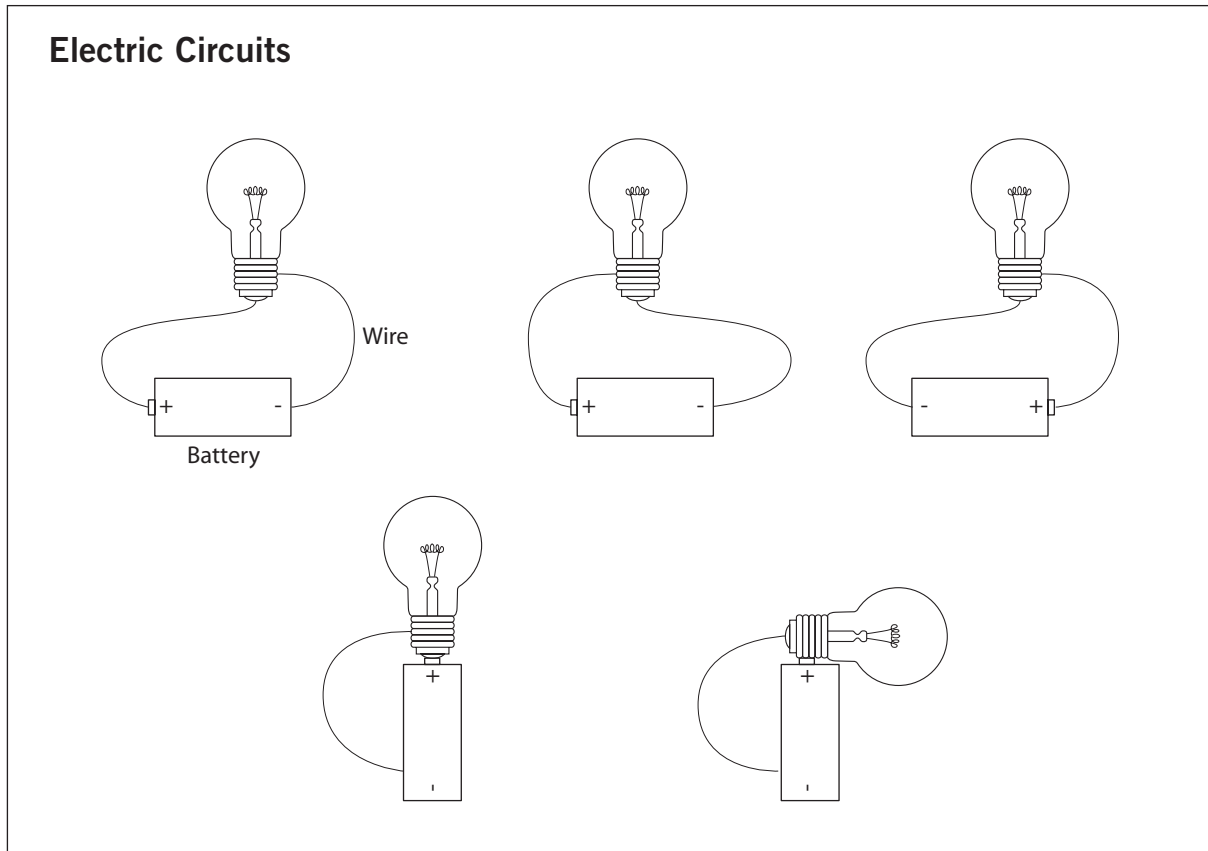
Here are some diagrams of electrical equipment:





2.5 Simple circuits

Here are some diagrams of circuits:





2.6 Electrical safety

The SESE: Science Teacher Guidelines page 96 provides information about electrical safety and the safe use of electrical equipment. Safety resources are available from **Understanding Energy**, for further information see the end of section 4. Your school may have the ESB *Bright Sparks* video and other safety resources.

There are some essential points to note:

- Mains electricity should not be used for electricity investigations.
- Don't use rechargeable batteries.
- Store batteries separately from wires.

2.7 Glossary of electrical terms

battery	Cells that produce electricity; a battery provides a voltage to a circuit e.g. 1.5 V
circuit	The complete path of an electric current through wires and a battery. If there is a break in the circuit the current will not flow.
conductor	A material that allows electricity to flow through it
electric current	Flow of electric charge through a conductor
filament	A very thin wire used in light bulbs. When a current flows through the filament it glows.
insulator	A material that does not allow electricity to flow
parallel circuit	A circuit where there is more than one path for electric current to flow
series circuit	A circuit where there is only one path for the electric current
static electricity	Charge that does not move, usually occurs on the surface of plastic when it is rubbed
switch	Any device used to break the connections in a circuit
voltage	The push a battery or cell gives a circuit to enable electric current to flow

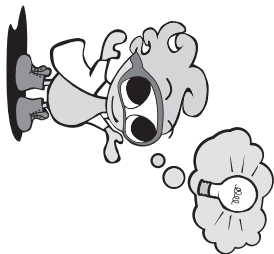
See also the SESE: Science Teacher Guidelines page 154.

Electricity in the Primary Science Curriculum

Content Strand	Infants	First and Second class	Third and Fourth class	Fifth and Sixth class
Energy and Forces	The child should be enabled to	The child should be enabled to	The child should be enabled to	The child should be enabled to
Electricity	<ul style="list-style-type: none"> become aware of the uses of electricity in school and at home identify some household appliances that use electricity become aware of the dangers of electricity 	<ul style="list-style-type: none"> explore the effects of static electricity become aware of the uses of electricity in school and at home identify some household appliances that use electricity become aware of the dangers of electricity 	<ul style="list-style-type: none"> explore the effects of static electricity explore the effects of static electricity plastic, ruler, comb, glass rod observe the effects of static electricity on everyday things in the environment <i>use of lightning conductor on buildings use of earthing strips for cars</i> learn about electrical energy investigate current electricity by constructing simple circuits <i>use wires, bulbs and batteries experiment with simple switches design and make a marine warning system (e.g. buoy with light or buzzer, lighthouse)</i> examine and group materials as conductors (those that conduct electricity) and insulators (those that do not allow electricity to pass through) become aware of the dangers of electricity 	<ul style="list-style-type: none"> explore the effects of static electricity learn about electrical energy investigate current electricity by constructing simple circuits <i>use wire, bulbs, motors and batteries use more than one bulb in a circuit use more than one battery in a circuit experiment with simple switches design and make set of traffic lights using a simple circuit and switch</i> become aware of how some common electrical appliances work become aware of and understand the dangers of electricity <i>dangers of mains electricity in the home and at work the importance of fuses and circuit breakers for safety</i>

Skill Development

The lessons and follow-up activities in the pack develop the skills of working scientifically and designing and making.





3. Sample lesson plans

3.1 Science activity - Teacher's notes for infant classes.

Theme	Electricity
Objective	The child should be enabled to become aware of the uses of electricity in school and at home. SESE: Science curriculum page 26.
Background	Many things use electricity to make them work. We need to learn to use them safely.
Materials	Old magazines with pictures of everyday electrical appliances, scissors, sticking paste, crayons or pencils.
Introduction	Talk about the way things work in the classroom i.e. toy cars, doll's pram, the window, the light, the tape recorder, the computer etc. Children recognise that some objects work by pushing/pulling. Other objects need electricity to make them work.
Development of lesson	Children identify some objects in the classroom that need electricity to work, they talk about the way this happens, children may need to be given the terms plug, lead and socket. Children could recall and name electrical objects from home. Safety rules are discussed with the children i.e. the necessity to get an adult to plug appliances in to sockets, the danger of certain familiar electrical objects and to leave these things alone.
Follow up activities	Children look through old magazines, tear or cut four to six pictures of electrical appliances, paste them on to worksheet. They talk about their choice of pictures. Senior Infants could label the pictures. Make a class book of the completed worksheets



JUNIOR AND SENIOR INFANTS

Electricity

Name:

These things use electricity



3.2 Science activity - Teacher's notes for first and second classes.

This lesson is based on Exemplar 25 in Approaches to learning electricity and magnetism in the SESE: Science Teacher Guidelines pp 96-106.

Theme	Electricity
Objective	The child should be enabled to explore the effects of static electricity. SESE: Science curriculum page 44.
Background	Rubbing certain different objects together makes static electricity. Combing washed dried hair with a nylon comb makes static electricity. You may hear a 'click' sound or notice a tiny spark. The comb is charged and the electrical field around the comb pulls the hair towards it.
Introduction	Talk about what the children may have noticed when combing their hair. They may have heard a clicking sound or noticed their hair standing up and being pulled towards the comb. Very curly hair or smooth silky hair works best.
Suggested materials & equipment	Equal sized balloons, small plastic bottles, plastic biro, metal biro, tissue paper pieces, something made from wool eg. jumper, sweater, sock, piece of carpet etc. Ensure the balloons are inflated and tied with a piece of string. A balloon pump will make this task easier. This activity works best on a dry day.
Development of lesson	Ask the children what they think might happen if they rubbed a biro through their hair and placed it near the hair on their arm or a piece of tissue paper. One or two children might demonstrate for the class. The children may feel the pull of the biro on the hair of their arm as well as noticing this pull on the hair and tissue paper.
Task	<ul style="list-style-type: none"> ■ The children predict which objects if rubbed on the hair would behave like the plastic biro. The children test these objects and record their observations. ■ It is best to rub the balloons etc. one way. The children will discover that they will need to rub the objects several times against a head of hair to charge them effectively.
Recording	<ul style="list-style-type: none"> ■ The children then try to charge the objects on the woollen materials or on a garment or arm hair, predict how they will behave and record their observations.
Analysing	The children will share their observations and discuss which objects they were able to charge.
Follow up activities	Exemplar 25 SESE: Science Teacher Guidelines shows other ways of exploring and developing static electricity.



FIRST AND SECOND CLASSES

Electricity

Name:

My recording:

Name of Object	Picked up paper Yes/No
Balloon	
Plastic bottle	
Plastic biro	
Metal biro	



3.3 Science activity - Teacher's notes for third and fourth classes.

This lesson is based on one of the exemplar 26 in Approaches to learning electricity and magnetism in the SESE: Science Teacher Guidelines pp 96-106.

Theme	Electricity
Objective	The child should be enabled to investigate current electricity by constructing simple circuits. SESE: Science curriculum page 64.
Background	Electricity flows when there is a complete circuit (See section 2.3).
Suggested materials and equipment	<p>Task A: 1.5 V battery, a 1.5 V bulb Two wires bared at the ends</p> <p>Task B: 1.5 V battery, a 1.5 V bulb One wire bared at the ends</p> <p>Task C: 1.5 V battery, a 1.5 V bulb Two wires bared at the ends.</p> <p>A bulb holder, a battery holder and a screwdriver.</p> <p>NB. The children need to be told that screwdrivers are sharp and must be used with care.</p>
Introduction	Introduce the 1.5 V battery as a source of electricity, which can be safely used. Develop into lesson.
Development of Lesson - Task A	Can you get a bulb to light?
Predicting	Encourage the children to predict how they might make this happen.
Investigating	Encourage the children to try different ways of connecting the wires to the bulb and battery until they succeed in lighting the bulb. Don't rush the children as the task may take some time. Simple circuits are drawn in section 2.5.
Recording	The children should draw all their circuits on the sheet provided. These annotated drawings help with the assessment of their work.
Task B	How many ways can you light the bulb using a battery, a bulb and one wire? Record as before. NB. The concept of "circuit" should be introduced after task B and the structure of the bulb explained by diagram (See sections 2.3, 2.7).
Task C (If time permits)	Construct a circuit using a 1.5 V battery, 1.5 V bulb, a battery holder, a bulb holder and two wires with their ends bared.
Analysing	Children should examine the structure of the bulb holder to trace the pathway of the electricity. Record as above. NB. The bulb must be screwed in tightly and the bare wire ends bound and trapped under the screws of the bulb holder to ensure good contact.
Discuss	The children should discuss their findings and be encouraged to draw conclusions from them.
Follow up activities	NB. This is a fundamental lesson in developing understanding of current electricity. Exemplar 26 SESE: Science Teacher Guidelines provides a comprehensive introduction to making a circuit. Section 4 has suggestions for further activities.



3.4 Science activity - Teacher's notes for fifth and sixth classes.

NB. The lesson for third and fourth classes deals with the fundamental concept of electrical circuits and should be completed before these activities.

Theme	Electricity
Objective	Investigate current electricity by constructing simple circuits. SESE: Science Curriculum page 86.
Background	An electric circuit is the complete path of an electric current through wires and a battery. If there is a break in the circuit the current will not flow. See section 2.5 for pictures of electric circuits.
Suggested materials and equipment	<ul style="list-style-type: none"> ■ 1.5 V battery, 2 x 1.5 V bulbs, 4 wires with their ends bared, 2 bulb holders, 1 battery holder and one screwdriver. NB: The children need to be told that screwdrivers are sharp and must be used with care.
Introduction	Discuss simple circuits with the children encouraging them to recap on the aspects covered in the 3rd and 4th class lesson.
Development of lesson	How many ways can you light 2 bulbs with (A) 3 wires and (B) 4 wires using the equipment mentioned above?
Task A Predicting	Organise the children in groups. Ask them to predict which combinations they think will make the bulbs light.
Investigating	The children will test their predictions by investigating the combinations.
Task B	As Task A but using 4 wires.
Extensions to Tasks A and B	What do you notice when there are two bulbs in a circuit? What is the effect of removing either bulb?
Recording	The children should draw all their circuits on the sheet provided.
Analysing	The children should discuss their findings and analyse them. Look up series and parallel circuits in section 2.7.
Follow up activities	Section 4 has suggestions for further activities.



4. Follow-up activities

Here are some suggestions for follow-up activities. For each activity class levels are suggested and an objective identified.

4.1 Making a safety poster

Infant classes

Objective: To help children to appreciate that electricity although useful is powerful and has to be treated with respect.

Materials: Sheets of paper, crayons, large sheet of sugar paper for collage.

Children are asked to illustrate in pictures their safety rules for electricity. The teacher could put in captions as appropriate.

4.2 Using electricity

Junior classes

Objective: To help children become aware of the uses of electricity.

Materials: Sheets of paper, crayons, large sheet of sugar paper for collage

Children can make a note of the different ways they use electricity each day e.g. watching television, listening to radio, cooking food, keeping food cold, making toast, washing clothes. They can then make a chart or collage to show these many different ways. They can sort common appliances into those that use batteries, those that use mains electricity and those that can use both.

4.3 Making a class book

Junior classes

Objective: To help children appreciate the way life was before electricity.

Materials: Sheets of paper, pencils, and crayons/colouring pencils. Scrap book.

Children illustrate one way life was without electricity and write a caption for their illustration. Illustrations are then put into a scrap book for the reading corner. Children could also make display of old artefacts i.e. candle holder and candle, old oil lamp, hot water bottle/jar, washboard etc, toys i.e. marbles, books, dolls/teddy.

4.4 Static electricity

Middle classes

Objective: To enable children to explore static electricity.

Materials: Strips of plastic (10-15 cm long and 3-4 cm wide)

The children should get two strips of plastic. They hold them together and rub them quickly. Then bring them near something that has an electric charge e.g. a rubbed plastic pen. The two strips of plastic should move apart. This is a simple electroscope; it tells you if something has an electric charge.



4.5 Examining a torch

Middle classes

Objective: To enable the children to investigate current electricity.

Materials: Torches, as many as possible.

Check the torches are working. Get the children to take them apart. See if they can find out how the bulb lights. They can investigate what happens when they move the switch, when they change the battery or batteries around. Then they put the torch together again so that it works. Then they can draw how the torch works. This is useful as an introduction to circuits or as a follow on from basic circuits.

4.6 Conductors and insulators

Middle classes

Objective: To enable the children to examine different materials and group them as insulators or conductors.

Materials: Batteries, bulbs, wire and a variety of everyday materials

Children can be asked explore all the materials which let electricity pass through. Then they can design a simple circuit to test different materials. This is developed in Exemplar 27 SESE: Science Teacher Guidelines.

4.7 Making a lighthouse

Middle classes

Objective: To design and make a lighthouse

Materials: Battery, bulb, wires, simple switch and materials for making the lighthouse

The children can *explore* lighthouses by looking up references books and finding out about them. Then they can *plan* how to make a lighthouse. They can plan their circuit and then plan how it would be housed. They will consider the materials and the tools they will need for the lighthouse. Children should be encouraged to *make* their lighthouses based on their design. Finally they can *evaluate* it by testing the lighthouse.

4.8 More circuits

Senior classes

Objective: To enable the children to construct a variety of simple circuits.

Materials: Batteries, wires, buzzers and motors

The children can experiment with batteries, buzzers and motors. They can make a circuit with batteries, wires and a buzzer. They will know when the buzzer works, it makes a sound. They can test their circuit. Then they can investigate what happens when they change the buzzer connections. Changing the batteries around can follow this. They can draw their circuits. (Many buzzers need 3 V i.e. 2 x 1.5 V batteries to work.) Then they can make a circuit with batteries, wires and a motor. They will hear the motor moving and see the spindle of the motor turning when they complete the circuit. Again they can draw their circuit.



4.9 Electrical appliances

Middle, senior classes

Objective: To enable children to learn about electrical energy and become aware of how some common electrical appliances work.

Children can survey their school and homes to identify the range of electrical appliances used. They can make a list of all the appliances and investigate what they use electrical energy to do. In the middle classes they can see that washing machines use electrical energy to heat water and to turn clothes around inside the machine. Toasters use electrical energy to heat wires to brown bread. Radios use electrical energy to make sound. In the senior classes they can start to investigate the equipment inside common appliances, e.g. a washing machine uses a motor to turn clothes in the drum. This is a development of activity 4.2.

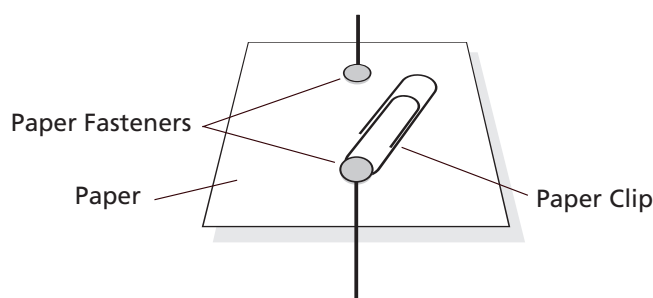
4.10 Making a switch

Senior classes

Objective: To make a simple switch.

Materials: Paper clips, paper fasteners, cardboard, wire, bulb and battery.

The children can design and make a simple switch. One simple design has two wires connected to paper fasteners and a paper clip attached to one paper fastener. When the paper clip is moved it completes the circuit.



Note:

There are many other possible activities which can be undertaken when exploring electricity. The school could have an electricity safety week when the children consider how they can use electricity safely at school, at home and on the farm.

The ESB is part of the Understanding Energy consortium. This is the education service of the major energy companies in Ireland and Britain. It has many resources for energy, particularly electricity. All the resources are available to Irish schools and many are free. The catalogues can be seen on the website at www.energy.org.uk/. An order form can be downloaded and the material ordered. Online materials are also available.



5. References

Association for Science Education. **Be Safe Third Edition**. ASE: Hatfield, 2001. ISBN 0 86357 324 X

Hollins, Martin and Whitby Virginia, **Progression in Primary Science. A guide to the Nature and Practice of Science in Key Stages 1 and 2**, London: David Fulton Publishers, 1998. ISBN 1 85346 498 8

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Government of Ireland. **Primary Curriculum. SESE: Science Teacher Guidelines**. Dublin: Stationery Office, 1999. ISBN 0 7076 6337 7

Nobel, Trevor, J. **Electricity a practical handbook for young people**. An educational booklet produced by the Electricity Supply Board.

Nuffield Primary Science. **Understanding Science Ideas. A Guide for Primary Teachers**, London: Collins Educational, 1997. ISBN 0 00 310018 9

Peacock, G.A., **Teaching Science in Primary Schools**, London: Letts Educational, 1999. ISBN 1 85805 351 X

Children's science series such as the **Kingfisher** books, **Star Science**, **Hands On Science** are useful references for electricity.



6. Evaluation Form

Please complete and return to STI Awareness Programme, Forfás, Wilton Park House, Wilton Place, Dublin 2 in the stamped addressed envelope provided with this teacher's pack.

Part 1 School information

- 1.1 School Name
- 1.2 School Address
- 1.3 Roll No.
- 1.4 School Phone No.
- 1.5 Email
- 1.6 Did you use the pack in English or as Gaeilge? English Gaeilge

Part 2 Evaluating the pack

Please rate the following sections of the pack for their clarity, usefulness etc. by circling 1 - 5 5= your most positive score: 1 = your most negative score

Section 2 Supporting information

	Poor	Fair	Good	V good	Excellent
2.1 How to use this pack	1	2	3	4	5
2.2 Electricity in the primary science curriculum	1	2	3	4	5
2.3 Background information on electricity	1	2	3	4	5
2.4 Equipment supplied	1	2	3	4	5
2.5 Comment	_____				

Section 3 Sample lesson plans

	Poor	Fair	Good	V good	Excellent
3.1 Sample lesson plan for infants	1	2	3	4	5
3.2 Reaction of children to the activity	1	2	3	4	5
3.3 Equipment supplied	1	2	3	4	5
3.4 Comment	_____				
3.5 Sample lesson plan for first and second classes	1	2	3	4	5
3.6 Reaction of the children to the activity	1	2	3	4	5
3.7 Equipment supplied	1	2	3	4	5
3.8 Comment	_____				



	Poor	Fair	Good	V good	Excellent
3.9 Sample lesson plan for third and fourth classes	1	2	3	4	5
3.10 Reaction of the children to the activity	1	2	3	4	5
3.11 Equipment supplied	1	2	3	4	5
3.12 Comment	_____				

3.13 Sample lesson plan for fifth and sixth classes	1	2	3	4	5
3.14 Reaction of the children to the activity	1	2	3	4	5
3.15 Equipment supplied	1	2	3	4	5
3.16 Comment	_____				

Section 4 Follow-up activities

4.1 Were any of the suggested follow-on activities included in the pack used by any teachers and pupils in your school?

Yes No

If yes, please specify

Activity	Class level
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____

4.2 What other science topics would you like to see included in a similar pack in the future?

4.3 If you have any suggestions for the development of this pack please specify.

Thank you for taking time to complete this questionnaire.