

# ELECTRICITY

## KEY STAGE

TEACHING AND LEARNING ACTIVITIES
Identifying, categorising and counting electric appliances in each room and corridor
Mapping position of electrical appliances in classroom and school
Observing and discussing electrical appliances at home and at school
Discussing the way people lived before electricity was generally available
Making simple electrical circuits
Using electricity safely
Using electricity wisely

Calculating running costs of appliances
Recording electricity meter readings and calculating expected bills
Checking electricity bills
Investigating which materials conduct electricity
Investigating the role of components
Using drawing and conventional symbols to design circuits with specific functions; making and testing them
Devising a system to switch a lamp on or off in response to natural light levels
Building, testing and evaluating ways of using wind and water power to generate electricity
Understanding how electricity has affected people in the past
Looking at the impact on the environment of electricity generation and distribution
Action to reduce adverse environmental impact

Analysing electricity bills
Estimating usage and running costs of electrical appliances and cost of wasted electricity
Investigating electricity use at different times of day, week, month, year
Investigating electronic devices
Making electromagnets
Investigating electromagnetic devices
Investigating ways of generating electricity, including exploiting renewable sources of energy
Appreciating the convenience and limitations of electricity as a way of transferring energy from place to place
Making working models of automatic control systems for room lighting and heating
Investigating the impact of electricity on where, when and how people work.
Electricity generation and transport as major contributors to climate change

Measuring electricity consumption and calculating costs
Investigating relationships between components in electrical circuits
Studying how electricity is generated and distributed
Understanding domestic wiring and appliances

ESD topics/activities in shaded areas

KS1

### CURRICULUM LINKS

<b>Maths</b>	Counting, recording and presenting results	(Num 4.2)
<b>Science</b>	Everyday appliances that use electricity	(PP 1.1)
	Simple electrical circuits and switches	(PP1.2-3)
<b>D&amp;T</b>	Electrical circuits and switches	(1.3)
<b>ICT</b>	Enter and store information	(1.2)
<b>History</b>	Lifestyles at different times	(2.1)
<b>Geog</b>	Make and use maps	(1.7)

KS2

<b>Maths</b>	Measure and money	(Num 3.1)
<b>Science</b>	Electrical insulators and conductors	(MP 1.3)
	Effects of changing components	(PP 1.3/4)
	Design and make electrical circuits that achieve results	(PP 1.5)
<b>D&amp;T</b>	Electrical circuits that achieve results	(1.3)
	Designing and making	(2 & 3)
<b>ICT</b>	Spreadsheets	(2.2)
<b>History</b>	Changes in housing, industry and transport	(2.1)
<b>Geog</b>	Windfarms	(3.3)
	Individual responsibility	(3.5)

KS3

<b>Maths</b>	Construct and interpret graphs	(Alg 1.3)
<b>Science</b>	Electrical conductors/insulators	(MP 1.11/12)
	Electrical circuits and current	(PP 1.4-8)
	Electromagnetism	(PP1.11)
	Electrical generation	(PP1.12, PP 5.3)
<b>D&amp;T</b>	Sensors and switches in control circuits	(1.2-3)
	Feedback	(1.5)
	Designing, making and evaluating	(2 & 3)
<b>ICT</b>	Data-handling and analysis	(1.4-5)
<b>History</b>	The world of work	(2.1)
<b>Geog</b>	Global environmental change	(3.10)

REFERENCES ARE TO DOUBLE SCIENCE

<b>Maths</b>	Calculation of electricity costs	(Sci: PP 1.11)
<b>Science</b>	Relationships in circuits	(PP 1.1-7)
	Mains electricity	(PP 1.8-11)
	Charge and EMF	(PP1.12-15)
	Generation	(PP1.16-19)

# SOME RESOURCES

Title	Links	KS	Teachers' Ref	Pupils' booklets	Work cards	Website www.	Contact Information
<b>Energy – a source of wonder</b> – Introduction to energy	■ ■ ■ ■ ■	1	✓			nea.org.uk	NEA
<b>Finding out about Domestic Energy</b> – How is it produced? – Activities and background notes	■ ■ ■ ■ ■	2	✓			nea.org.uk	NEA
<b>Illuminated Numbers</b> – using a lighting survey as a context for Mathematics, etc	■ ■ ■ ■ ■	2	✓			create.org.uk	CREATE
<b>Save Your Energy</b> – Software package for assessing energy efficiency of pupils' homes	■ ■ ■ ■ ■	2	✓	✓		create.org.uk	CREATE
<b>Systematic</b> - Making the school more energy economical by looking at inputs, processes and outputs	■ ■ ■ ■ ■	2	✓			york.ac.uk/org.ceic	Chemical Industry Education Centre
<b>Teaching about Energy</b> – Guidance for teachers	■ ■ ■ ■ ■	2	✓			southgatepublishers.co.uk	Southgate
<b>Energy Works</b> - Visiting hands-on exhibition	■ ■ ■ ■ ■	2-3				science-project.org	Science Projects
<b>Energy Matters</b> – Activities and support with built-in progression between Key Stages	■ ■ ■ ■ ■	2-3	✓		✓	cse.org.uk	Centre for Sustainable Energy
<b>Practical Energy Project Pack</b> – Activities cover fuel consumption, costs, insulation, lighting, etc	■ ■ ■ ■ ■	3	✓	✓	✓	create.org.uk	CREATE
<b>Fossils into Fuels</b> – Overview of geology and industry, activities, teachers' notes, etc	■ ■ ■ ■ ■	3-4	✓			petroleum.co.uk	Institute of Petroleum
<b>Fuel for thought</b> – Cross-curricular view of energy in its environmental and social contexts	■ ■ ■ ■ ■	3-4	✓			nea.org.uk	NEA
<b>Canllawiau i Athrawon – Ynni Gwynt, Ynni Dŵr a Trydan Solar Teachers' Guides to Wind, Water and Solar Power</b> } Linked to guides for young people	■ ■ ■ ■ ■	3-4	✓			cat.org.uk	Canolfan y Dechnoleg Amgen Centre for Alternative Technology
<b>Electricity Through the Ages</b> – Eleven colourful posters	■ ■ ■ ■ ■	3-4				understanding_energy.org.uk	Understanding Energy
<b>Solar Fact Sheets</b> – Six-part set covers water-heating, photovoltaics, biomass, etc	■ ■ ■ ■ ■	3-4	✓		✓	brookes.ac.uk/uk-ises	Solar Energy Society
<b>Environmental Effects of Electricity Generation</b> – Information for teachers and pupils	■ ■ ■ ■ ■	4	✓		✓	iee.org.uk/Schools/curricul.htm	Institution of Electrical Engineers
<b>Classroom Modules on Oil</b> – Worksheets and video covering the practical side of the oil industry	■ ■ ■ ■ ■	4	✓		✓	energychest.net	Esso
<b>Power Challenge</b> – Extensive role-play package deals with a new power station	■ ■ ■ ■ ■	4	✓		✓	ase.org.uk	Association for Science Education
<b>Managing Energy</b> – Investigations involving students in school energy management	■ ■ ■ ■ ■	4	✓		✓	ase.org.uk	Association for Science Education
<b>Exploring Geography series</b> - Book 1 deals with renewable energy	■ ■ ■ ■ ■	4	✓			www.wjec.co.uk	Welsh Joint Education Committee
<b>Teaching Energy and Energy Efficiency Effectively</b> – Guidance for non-specialist teachers	■ ■ ■ ■ ■		✓			ase.org.uk	Association for Science Education
<b>Energy Efficiency Lesson Plans for Trainee Teachers</b> – Ideas and worksheets	■ ■ ■ ■ ■		✓			nea.org.uk	NEA
<b>Building energy efficiency in schools</b> – The key publication on the whole school approach to energy management	■ ■ ■ ■ ■		✓				BRECSU
<b>EnergyWatch</b> - free termly newsletter for teachers	■ ■ ■ ■ ■		✓			create.org.uk	CREATE
<b>SchoolEnergy Programme</b> – improving energy efficiency through pupil involvement	■ ■ ■ ■ ■		✓			schoolenergy.org.uk	CREATE
<b>Eco-Schools Award Scheme</b> – Recognition for schools that are reducing their adverse environmental impact. Eco-Schools Handbook available in Welsh (Eco-Ysgolion Llawlyfr)	■ ■ ■ ■ ■		✓			eco-schools.org.uk	Eco-Schools Award Scheme

For further information about these and many other titles see Openings! – a guide to Quality Energy Education Materials published by CREATE on behalf of the Energy Education Forum. This is available from Kentley House, 25 Bridgeman Terrace, Wigan WN1 1TD or on [www.create.org.uk](http://www.create.org.uk)

Links Key: ■ Heat and combustion ■ Light ■ Sound ■ Electricity

**SOUND**

**LIGHT**

**HEAT AND COMBUSTION**

**ELECTRICITY**

# **ENERGY ZONE**

*A guide for  
teachers  
to the location  
of energy-  
related topics  
in the National  
Curriculum in  
Wales  
and some of  
the resources  
available to  
assist teaching*

*“Looking for a way to use the school buildings as an educational resource for primary Mathematics?”*

*“Need ideas on ways to link energy concepts in secondary Science and Geography with action dealing with real world problems?”*

# ENERGY ZONE

This curriculum map will assist teachers when planning their teaching programmes. It shows where energy...

- is required by the National Curriculum in Wales,
- can be used as a context for delivering stipulated topics.

It also demonstrates the progression of understanding through the Key Stages.

## **Energy and Education for Sustainable Development**

The National Curriculum in Wales requires that Education for Sustainable Development (ESD) is covered in Geography and PSE. In addition, there are opportunities and contexts in other subjects to develop the concept of sustainable development. Energy is a good introduction to both the theory and practice of sustainable development because...

- it allows pupils to translate general concerns about the environment and good citizenship into practical action within their schools and homes at all times of the year,
- energy consumption is already quantified, so improvements in energy efficiency can be identified quickly and then celebrated by the pupils involved,
- wiser use of energy leads to improved levels of pupil and teacher comfort, together with cash savings that can be put to educational uses.

The SchoolEnergy Programme encourages effective energy management in schools that involves pupils as well as adults through a whole school approach to energy.

## **Using the Map**

Curriculum statements involving energy are allocated to one or more of four traditional themes – Sound, Light, Heat & Combustion and Electricity, together with the references to the National Curriculum subject handbooks.

Shaded areas are used to indicate where...

- ESD is a stipulated requirement of a National Curriculum subject,
- learning activities can be used to deliver ESD.

Language is basic to the understanding and discussion of energy and co-ordinating action to ensure its wise use. So energy can be used as a context for work in Welsh, English and foreign languages. This can be reinforced through using energy as a theme in Art and Design and Music, and within schools' own programmes of drama, health, social, environmental, and economic education.

This leaflet is based on a concept developed by the Aberdeen Environmental Education Centre and is used with their kind permission

# SOUND

## KEY STAGE

TEACHING AND LEARNING ACTIVITIES	KEY STAGE	CURRICULUM LINKS
Investigating how sounds are made	KS1	<b>Science</b> Types and sources of sound (PP3.3)
Recognising everyday sounds		Sounds travel from sources, getting fainter (PP3.4)
Differentiating between loud and quiet sounds		Ear and hearing (PP 3.5)
Identifying materials that absorb sound energy and those that don't		
Inquiring into hearing		
Using sound sources safely in the home and school		
Role-play/discussion dealing with not letting sound upset other people		
Investigating the sources of energy required to make sounds (e.g. manual, mechanical, electrical)	KS2	<b>Science</b> Sounds are made when objects vibrate (PP3.6)
Investigating the transmission of sound		Vibrations require a medium in which to travel (PP3.8)
Differentiating pitch and volume		Changes in pitch and loudness (PP3.7)
Sound is one way of transferring energy		<b>D&amp;T</b> How the properties of materials affect how they can be used (1.1)
Identifying situations where materials that absorb/don't absorb the energy of sound will be useful		<b>ICT</b> Use of ICT equipment (1.1)
Using computers to control flow of energy to sound-making devices		
Investigating the ear and hearing, pitch and volume discrimination	KS3	<b>Science</b> Light travels faster than sound (PP3.2)
Investigating how sound energy is carried from place to place		Sound cannot travel through a vacuum (PP3.12)
Examining (model) systems, based on sound detectors, that automatically switch lighting on and off to reduce energy waste		Loudness and amplitude (PP3.13)
		Pitch and frequency (PP 3.14)
		Reflection of sound (PP 3.15)
		Sound and the ear (PP 3.10)
		Effect of loud noise on the ear (PP 3.11)
	<b>D&amp;T</b> Control systems (1.3)	
Comparing perceived volume of sounds with amplitude	KS4	REFERENCES ARE TO DOUBLE SCIENCE
Building a (model) system, based on noise detectors, to automatically switch lighting on and off		<b>Science</b> Sound waves (PP3.1-4)
		Energy transfer (PP3.5)

ESD topics/activities in shaded areas

# LIGHT

## KEY STAGE

TEACHING AND LEARNING ACTIVITIES
Investigating how light helps us to see things
Observing lamps, torches, indicators and other sources of light around the school and their differences in brightness
Investigating how sources of light influenced buildings and lifestyles in the past
Plotting the paths of patches of sunlight and shadow across the classroom
Investigating shiny and dull objects
Simple survey lighting
Discussing how lighting systems work and are controlled
Growing seedlings in light and dark

Measuring and mapping lights and light levels within a school building and deciding if they are appropriate for normal activities
Calculate lighting costs
Observing automatic lighting controls systems
Predict energy and cost savings of switching off unnecessary lights
Creating and investigating beams of light, shadows and mirrors
Investigating the eye and seeing
Investigating the effects of light and the use of leaves in plant growth
Discovering how energy is passed from organism to organisms as food
How farmers have increased production of crops and stock by improvements in the effectiveness of capturing the energy of light

Measuring light levels and plotting intensity in a plan of the classroom
Investigating the role of natural and artificial light
How sources of light (natural and artificial) influenced daily life at home and work
Investigating visibility of coloured objects when seen by coloured lighting
Calculating and presenting lifetime costs of filament and fluorescent lamps
Using a light sensor as an input to a (model) system to control room lighting and thus reduce electricity consumption
Investigating light rays, mirrors, prisms, etc
Investigating leaves and energy capture
Studying dormancy and hibernation

Investigating sight and seeing
Experimenting with mirrors and lenses
Investigating waves
The uses and dangers of different parts of the electromagnetic spectrum
Investigation of factors affecting photosynthesis
Uses to which energy stored as sugars and starch are put
Investigating food/energy flows in ecosystems

ESD topics/activities in shaded areas

KS1

### CURRICULUM LINKS

<b>Maths</b>	Classify and record	(Num 4.1-2)
<b>Science</b>	Light sources and darkness	(PP 3.1)
	Plants need light	(LPLT 3.1)
<b>D&amp;T</b>	Control in everyday devices	(1.3)
<b>ICT</b>	Enter and store information	(1.2)
<b>History</b>	Buildings in the past	(4.1-2)
<b>Geog</b>	Making use of maps and plans	(1.7)

KS2

<b>Maths</b>	Collect and represent data	(HD 1.2)
	Measure and money	(Num 3.1)
<b>Science</b>	Light and seeing	(PP3.1-4)
	Creation of shadows	(PP3.5)
	Light and plant growth	(LPLT 3.1-2)
	Food (energy) chains	(LPLT4.3-4)
<b>D&amp;T</b>	Control systems	(1.3)
<b>ICT</b>	Use spreadsheet	(2.2)
<b>History</b>	Food and farming	(2.1)
<b>Geog</b>	Observe, collect and record information	(1.5)

KS3

<b>Maths</b>	Collect and represent data	(HD 1.3)
	Maps and scales	(SSM 2.4)
<b>Science</b>	The Sun as a source of light	(PP 4.4)
	The behaviour of light	(PP3.1-6)
	Electromagnetic spectrum	(PP3.6-9)
	Photosynthesis and chloroplasts	(LPLT 1.3/3.1-3)
	Survival of seasonal change	(LPLT 5.2)
	Food (energy) chains and webs	(LPLT 5.5-6)
<b>D&amp;T</b>	Control systems	(1.3)
<b>History</b>	Characteristics of periods	(2.1)

KS4

REFERENCES ARE TO DOUBLE SCIENCE

<b>Science</b>	The working of the eye	(LPLT 2.14)
	Reflection and refraction	(PP 3.1)
	Electromagnetic spectrum	(PP3.6-11)
	Energy transfer by waves	(PP 3.5)
	Photosynthesis	(LPLT3.1-2)
	Food chains	(LPLT 5.2, 5.5-8)

# HEAT AND COMBUSTION

KEY STAGE	
<b>KS1</b>	<b>CURRICULUM LINKS</b>
<b>TEACHING AND LEARNING ACTIVITIES</b>	
Investigating materials and discussing if they will keep things hot or cold	<b>Maths</b> Temperature scale (Num 1.3, SSM 3.2)
Explore the ways materials behave when they are heated or cooled	<b>Science</b> Food, eating and exercise (LPLT 2.4)
Cooking simple foods	Seasonal changes (LPLT 4.1)
Experiencing heat released during physical activity	Properties of materials (MP 1.2/4)
Recording daily temperatures inside and out	Changes during heating and cooling (MP 2.2)
Discussing how heating systems work and are controlled	<b>D&amp;T</b> Control in everyday devices (1.3)
Suggest how the school might be made more comfortable on hot and cold days	Food technology (2 & 3)
Finding out how parents and grandparents kept warm when they were children	<b>ICT</b> Application of ICT inside and outside school (p7)
Keeping doors and windows closed during cold weather	Enter and store information (1.2)
Realising that keeping the school warm costs money	<b>History</b> Changes in the way people lived (2.3)
	Buildings in the past (4.1-2)
	<b>Geog</b> Weather (1.5)
	Seasons (Sci: LPLT 4.1)
	Study of school buildings (1.7)
	Express views on changes (2.7)
<b>KS2</b>	
Comparing temperatures subjectively and with a thermometer	<b>Maths</b> Collect, record process data and present findings (HD 1.2)
Carrying out temperature surveys within the school building and deciding if they are appropriate for normal activities	Mathematical communication (UAM 2.2, HD 1.2)
Graphs to represent temperature changes over time	Standard units and money (Num 3.1, SSM 3,1)
Describing weather and explaining how it differs from place to place	<b>Science</b> Grouping and classifying materials (MP1.1-3)
Observe where ICT is used to control the school heating system	Temperature (MP 2.7)
Creating a sequence of instructions to monitor and control temperature in a room	Changing materials (MP 2.2-6)
Taking action to minimise energy wastage	Evaporation (MP 3.4)
Discovering thermal insulators and conductors	Water cycle (MP 2.8)
Describing what happens when materials are heated and cooled	Burning (MP2.4)
Preparing food	Reversible and non-reversible changes (MP 2.1)
Investigating evaporation and condensation	Temperature and plant growth (LPLT 3.1)
Investigating what happens when materials burn	<b>D&amp;T</b> Evaluating designs (2.5, 3.6)
Investigating effects of warmth and cold on plants	Food (2 & 3)
Deciding if designs meet environmental considerations e.g. for energy efficiency	Simple programming (1.4)
Studying how sources of energy influenced transport	<b>ICT</b> Store, process and present information (1.3)
	ICT in the wider world (p9)
	<b>History</b> Transport through the ages (2.1)
	<b>Geog</b> Comparing temperatures (1.3)
	Collecting temperature data (1.5)
	Making maps (1.7)
	Safeguarding the future (3.2)
ESD topics/activities in shaded areas	

KEY STAGE

KS3

TEACHING AND LEARNING ACTIVITIES	CURRICULUM LINKS
Collecting energy consumption data	<b>Maths</b> Handling data (HD 1.1-3)
Plotting and interpreting energy consumption	Line of best fit (Sci: SE 3.15)
Surveying attitudes to energy efficiency	Real-life graphs (Alg 1.3, 2.2-4)
Logging room temperature over a period of days to see if heating regime is appropriate	<b>Science</b> Respiration (LPLT 2.1/14-16 & 3.6)
Using weather and energy consumption data to evaluate effectiveness of control systems	Survival of seasonal change (LPLT 5.2)
Investigating solids, liquids and gases	Changes of state (MP2.1-5)
Investigating solubility of solids and gases	Temperature and solubility (MP2.2)
Demonstrating breaking of rocks (and bricks) by ice	Transfer and conservation of energy (MP2.11)
Studying fossil and other fuels, their formation, global stocks and depletion	Renewable and non-renewable energy resources (SE 2.4; PP 5.1-4)
Finding out about alternative fuels and renewable energy resources	Impact of combustion (MP 2.12)
Studying the effect of exploitation of energy resources on lifestyle and manufacturing	Distinction between temperature and internal energy (PP 5.5)
Taking action to reduce use of fossil fuels and pollution from burning	Thermal conductors/insulators (MP 1.11-12)
Investigating and using solar heating	Transfer of energy (PP 5.6)
Study school heating systems and controls	Storage of energy (PP 5.7)
Investigating practical applications within the school of techniques to minimise some energy transfers and maximise others	Conservation of energy (PP 5.8)
Observing the sensors and activators of the school heating system	Dissipation of energy (PP 5.9)
Writing programs that would mimic those used by heating controllers in the school to maximise comfort and minimise fuel consumption	<b>D&amp;T</b> Loop control systems (1.4)
	Heat treatment (3.3)
	<b>ICT</b> Using appropriate ICT equipment (1.2)
	Databases (1.4)
	<b>History</b> Technological, scientific and industrialisation developments of the 20th Century (2.1)
	<b>Geog</b> Weather and climate (3.3)
	Environmental issues (3.8-10)

KS4

TEACHING AND LEARNING ACTIVITIES	CURRICULUM LINKS
Plotting and interpreting monthly energy consumption of the school against a weather severity index. Indicating anomalies that could indicate malfunction.	<b>Maths</b> Handling/interpreting data (HD 1.2)
Investigating the use by and effects of heat on living things	Line of best fit (Sci: SE 3.15)
Carrying out fractional distillation	<b>Science</b> Respiration (LPLT 2.8/9)
Studying the uses of petroleum products	Constant temperature (LPLT 2.21)
Investigating the effect of heat on chemicals and reactions	Fossil fuel formation (MP 2.1)
Investigating gaseous and particulate pollution, climate change and acid rain and their effects on health	Crude oil (MP 2.2-3)
Studying radio-activity	Combustion (MP 2.4)
	Acid rain, climate change (MP1.23)
	Rate of reaction (MP 3.11/13)
	Catalysis and enzymes (LPLT 2.2; MP 3.14)
	Energy in reactions (MP 3.19-21)
	Energy transfers (PP 5.1-3)
	Thermal insulation (PP5.4)
	Energy efficiency (PP 5.5)
	Radioactivity (PP 6)
	Electrolysis (MP 2.12-14)
	Work, power and energy (PP 5.6-8)

REFERENCES ARE TO DOUBLE SCIENCE

ESD topics/activities in shaded areas