

Energy awareness

**Lessons:** 6

**Programming languages:** MakeCode, Python

**Target age:** 7-11 yrs, 11-14 yrs, 14-16 yrs

**Subjects & topics:**

* Global Goals: 13 Climate
* Computer systems: Input/output, Sensors
* Programming: Variables, Data handling
* Sciences: Energy, Working scientifically
* Mathematics: Money

# Unit of work summary

A unit of 4, 5 or 6 lessons exploring energy use around us. Students learn how we can monitor our use of energy and use this to make decisions about how we can save energy, save money and have a positive impact on climate change.

Students use micro:bits to monitor electric light use, learn about how to collect good data and present it in order to help inform decisions about changing behaviours.

## Overall key learning

* to understand Global Goal 13 (climate action) and why it's relevant to us
* to think about energy use around us and how we can use data to make decisions and drive change in behaviours
* to understand what ‘good data’ looks like and plan the collection of good data
* to collect, process and analyse data, visualising it to make it easier to interpret and present.
* to use the information collected to make suggestions for reducing energy use, saving money and reducing our impact on climate change
* to calculate energy use in kWh and cost
* to present complex findings and demonstrate skills used in a way that is appropriate to a given audience
* can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation
* are responsible, competent, confident and creative users of information and communication technology

## Additional skills

Researching, presenting, collaboration, evaluation

## Lesson 1: Energy around us

Students relate the UN Global Goals on Climate action to the use of energy in their school or home and start planning where to use the micro:bit to collect data about electric light usage.

**Key learning:**

* Understand what UN [Global Goal 13 (climate action)](https://microbit.org/teach/do-your-bit/global-goals/climate-action/) is and why it’s relevant to us
* Understand how our energy use can have an impact on climate change
* To consider and plan how we might monitor our energy use at home or at school and how awareness can drive changes in behaviour

## Lesson 2: Energy data planning

Students program a BBC micro:bit to measure light readings and plan where reliable energy usage data can be gathered.

**Key learning:**

* Understand the importance of planning when collecting data to ensure it is reliable
* Program a micro:bit to take measurements of environmental data (a light meter to measure light levels)
* Understand the importance of baseline measurements and calibration when collecting data

## Lesson 3: Energy data collecting

Students program and calibrate their micro:bit light timers and place them in their chosen locations to record energy use data.

**Key learning:**

* To calibrate and deploy a data logger (micro:bit light timer)
* To collect environmental data (light usage) over time

## Lesson 4: Energy data processing

Students collate, process and analyse light usage data. They plot simple charts to help them to visualise data, spot patterns and suggest solutions to modify behaviour and save energy.

**Key learning:**

* Collate and process numerical data
* Present numerical data in visual form
* Analyse data and make inferences from it about energy use
* Use these inferences to make proposals to modify behaviour to save energy

## Lesson 5: Energy use calculations

Students build on previous lessons, analysing energy use patterns by calculating the amount of energy used and its cost.

**Key learning:**

* Calculate the amount of energy used in kWh given the time and power consumed by electric lighting
* Calculate the cost of energy used from previously recorded data

## Lesson 6: Energy presentations

Students review all their findings from previous lessons and create a presentation which they could give to the rest of their class, year group, school leadership, parents or governors.

**Key learning:**

* Demonstrate an understanding of factors affecting the reliability of data collection.
* Show how data can be analysed to drive decisions to encourage behaviour change.
* Explain how problems were approached and the skills used.
* Present complex information in a way that's appropriate to the audience.

# Curriculum links

## England National Curriculum

#### KS2 computing curriculum

Curriculum aims:

* can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation
* are responsible, competent, confident and creative users of information and communication technology

Students should be taught to:

* select, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of programs, systems and content that accomplish given goals, including collecting, analysing, evaluating and presenting data and information

[Read the full KS2 computing curriculum](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/239033/PRIMARY_national_curriculum_-_Computing.pdf)

#### KS3 computing curriculum

* undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users
* create, reuse, revise and repurpose digital artefacts for a given audience, with attention to trustworthiness, design and usability

[Read the full KS3 computing curriculum](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/239067/SECONDARY_national_curriculum_-_Computing.pdf)

#### KS4 computing curriculum

* develop their capability, creativity and knowledge in computer science, digital media and information technology

[Read the full KS4 computing curriculum](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/239067/SECONDARY_national_curriculum_-_Computing.pdf)

#### KS2 mathematics curriculum

**Year 4 - measurement:**

* estimate, compare and calculate different measures, including money in pounds and pence

**Year 4 - statistics:**

* interpret and present discrete and continuous data using appropriate graphical methods, including bar charts and time graphs.

**Year 5 - measurement:**

* use all four operations to solve problems involving measure [for example, length, mass, volume, money] using decimal notation, including scaling.

**Year 5 - statistics:**

* complete, read and interpret information in tables, including timetables.

[Read the full KS2 mathematics curriculum](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/335158/PRIMARY_national_curriculum_-_Mathematics_220714.pdf)

#### KS3 mathematics curriculum

**Number:**

* use standard units of mass, length, time, money and other measures, including with decimal quantities
* use a calculator and other technologies to calculate results accurately and then interpret them appropriately

**Statistics:**

* construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped

#### KS2 science curriculum

**Working scientifically - Year 5 & 6**

* planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
* taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
* recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
* using test results to make predictions to set up further comparative and fair testsreporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations
* identifying scientific evidence that has been used to support or refute ideas or arguments

[Read the full KS2 science curriculum](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/425618/PRIMARY_national_curriculum_-_Science.pdf)

#### KS3 science curriculum

**Working scientifically**

**Scientific attitudes**

* pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
* understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review
* evaluate risks

**Experimental skills and investigations**

* ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
* make predictions using scientific knowledge and understanding
* select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables
* use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety
* make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements
* apply sampling techniques

**Analysis and evaluation**

* apply mathematical concepts and calculate results
* present observations and data using appropriate methods, including tables and graphs
* interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
* present reasoned explanations, including explaining data in relation to predictions and hypotheses
* evaluate data, showing awareness of potential sources of random and systematic error
* identify further questions arising from their results

**Measurement**

* use and derive simple equations and carry out appropriate calculations
* undertake basic data analysis including simple statistical techniques

**Energy**

**Calculation of fuel uses and costs in the domestic context**

* comparing power ratings of appliances in watts (W, kW)
* comparing amounts of energy transferred (J, kJ, kW hour)
* domestic fuel bills, fuel use and costs
* fuels and energy resources

[Read the full KS3 science curriculum](https://www.gov.uk/government/publications/national-curriculum-in-england-science-programmes-of-study/national-curriculum-in-england-science-programmes-of-study)

#### KS4 science curriculum

**Working scientifically**

**The development of scientific thinking**

* using a variety of concepts and models to develop scientific explanations and understanding
* explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments

**Experimental skills and strategies**

* planning experiments to make observations, test hypotheses or explore phenomena
* carrying out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations
* making and recording observations and measurements using a range of apparatus and methods

**Analysis and evaluation**

Applying the cycle of collecting, presenting and analysing data, including:

* presenting observations and other data using appropriate methods
* translating data from one form to another
* carrying out and representing mathematical and statistical analysis

**Vocabulary, units, symbols and nomenclature**

* developing their use of scientific vocabulary and nomenclature
* recognising the importance of scientific quantities and understanding how they are determined
* using prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano)
* interconverting units
* using an appropriate number of significant figures in calculations.

#### KS2 DT curriculum

* apply their understanding of computing to program, monitor and control their products

[Read the full KS2 DT curriculum](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/239041/PRIMARY_national_curriculum_-_Design_and_technology.pdf)

## Scotland Curriculum for Excellence

#### Technologies

* I can explore and experiment with digital technologies and can use what I learn to support and enhance my learning in different contexts (TCH 1-01a)
* I can take appropriate action to ensure conservation of materials and resources, considering the impact of my actions on the environment (TCH 1-06a)
* I understand how technologies help provide for our needs and wants, and how they can affect the environment in which we live (TCH 1-07a)
* I can explore and comment on processes in the world around me making use of core computational thinking concepts and can organise information in a logical way (TCH 1-13a)
* I understand the instructions of a visual programming language and can predict the outcome of a program written using the language (TCH 1-14a)
* I understand how computers process information (TCH 1-14b)
* I can demonstrate a range of basic problem solving skills by building simple programs to carry out a given task, using an appropriate language (TCH 1-15a)
* I can extend and enhance my knowledge of digital technologies to collect, analyse ideas, relevant information and organise these in an appropriate way (TCH 2-01a)
* I can analyse how lifestyles can impact on the environment and Earth’s resources and can make suggestions about how to live in a more sustainable way (TCH 2-06a)
* I can make suggestions as to how individuals and organisations may use technologies to support sustainability and reduce the impact on our environment (TCH 2-07a)
* I understand the operation of a process and its outcome. I can structure related items of information. (TCH 2-13a)
* I can create, develop and evaluate computing solutions in response to a design challenge (TCH 2-15)
* I can identify the costs and benefits of using technologies to reduce the impact of our activities on the environment and business. (TCH 3-07a)
* I can describe the structure and operation of computing systems which have multiple software and hardware levels that interact with each other. (TCH 3-14b)
* I can present conclusions about the impact of technologies on the economy, politics and the environment. (TCH 4-07a)
* I can explain the overall operation and architecture of a digitally created solution (TCH 4-14b)

[Read the full Curriculum for Excellence: technologies](https://education.gov.scot/Documents/Technologies-es-os.pdf)

#### Numeracy and mathematics

* I can manage money, compare costs from different retailers, and determine what I can afford to buy (MNU 2-09a)
* When considering how to spend my money, I can source, compare and contrast different contracts and services, discuss their advantages and disadvantages, and explain which offer best value to me. (MNU 3-09a)

[Read the full Curriculum for Excellence: numeracy and mathematics](https://education.gov.scot/Documents/numeracy-maths-eo.pdf)

#### Sciences

* I am aware of different types of energy around me and can show their importance to everyday life and my survival (SCN 1-04a)
* By considering examples where energy is conserved, I can identify the energy source, how it is transferred and ways of reducing wasted energy (SCN 2-04a)
* Through exploring non-renewable energy sources, I can describe how they are used in Scotland today and express an informed view on the implications for their future use (SCN 2-04b)

[Read the full Curriculum for Excellence: sciences](https://www.education.gov.scot/Documents/sciences-eo.pdf)

## Northern Ireland Curriculum

#### Primary

#### Using ICT across the curriculum

* explore - access and manage data and information
* exhibit - manage and present their stored work

#### KS2 - suggested curriculum ideas for the world around us

* some of the ways people affect / conserve the environment both locally and globally
* how we might act on a local or global issue

#### KS2 - mathematics and numeracy

* number - money

[Read the full Northern Ireland curriculum - primary](https://ccea.org.uk/downloads/docs/ccea-asset/Curriculum/The%20Northern%20Ireland%20Curriculum%20-%20Primary.pdf)

#### KS1 & 2 - requirements for using ICT

* explore - investigate, make predictions and solve problems through interaction with digital tools

[Read the full KS1 & 2 requirements for using ICT](https://ccea.org.uk/downloads/docs/ccea-asset/Curriculum/Curriculum%20Requirements%20for%20Using%20ICT.pdf)

#### KS2 - the world around us

* the effects of positive and negative changes globally and how we contribute to some of these changes

[Read the full KS2 world around us curriculum](https://ccea.org.uk/downloads/docs/ccea-asset/Curriculum/Key%20Stage%202%20Statutory%20Requirements%20for%20The%20World%20Around.pdf)

#### Primary using ICT - desirable features - computational thinking and coding

**Level 4**

Pupils should:

* create a more sophisticated coding project using a broad range of commands; and/or
* solve a given problem using commands in a programming environment.

**Programmable devices (such as Parrot Drone, micro:bit or Sphere)**

* look at and talk about examples of coding projects, including the use of motion, looks, lights or sounds, sensors, control and events such as ‘if...then’ and ‘loop until’ (or equivalent) that make the code more efficient.

**Finally**

* share their work (possibly using digital tools), respond to feedback and comment on others’ work; and
* organise files and export work in an appropriate format so that others may view it.

**Level 5**

Pupils should:

* create more sophisticated coding projects using a broad range of commands and more than one platform; and

**Programmable devices (such as Parrot Drone, MicroBit or Sphero)**

* as a class look at and talk about examples of coding projects, including using multiple ‘if...then’ and ‘if...then...else’ commands, variables, sensors, events, operators and comparators;
* use a range of commands to create a project, including variables, operators and control statements such as ‘if... then...’ alongside the use of ’if...then...else’ and comparators;

**Finally**

* share their work (possibly using digital tools), respond to feedback, and comment on the work of others evaluating process and outcome; and
* organise files and publish work online (if available) so that others can view it.

[Read all Primary using ICT desirable features](https://ccea.org.uk/downloads/docs/ccea-asset/Curriculum/Primary%20Using%20ICT%20Desirable%20Features%20Update%202019.pdf)

#### Secondary

#### Science and technology - technology and design - statutory requirements, KS3

* explore technical inventions and designs that have met a social need cost-effectively
* demonstrate practical skills in the safe use of a range of tools, machines and equipment
* communicate effectively in oral, visual (including graphic), written, mathematical and ICT formats showing clear awareness of audience and purpose

[Read the full technology and design statutory requirements](https://ccea.org.uk/downloads/docs/ccea-asset/General/Statutory%20Requirements%20for%20Technology%20and%20Design%20at%20Key%20Stage%203.pdf)

#### Science and technology - science - statutory requirements, KS3

Develop skills in scientific methods of enquiry to further scientific knowledge and understanding:

* planning for investigations
* obtaining evidence
* presenting and interpreting results
* develop creative and critical thinking in their approach to solving scientific problems
* develop a range of practical skills, including the safe use of science equipment

Learn about:

* using electricity
* the environment and human influences

Learning outcomes:

* demonstrate a range of practical skills in undertaking experiments, including the safe use of scientific equipment and appropriate mathematical calculations
* use investigative skills to explore scientific issues, solve problems and make informed decisions
* research and manage information effectively, using Mathematics and ICT where appropriate
* show deeper scientific understanding by thinking critically and flexibly, solving problems and making informed decisions, using Mathematics and ICT where appropriate
* communicate effectively in oral, visual, written, mathematical and ICT formats, showing clear awareness of audience and purpose

[Read the full science statutory requirements](https://ccea.org.uk/downloads/docs/ccea-asset/General/Statutory%20Requirements%20for%20Science%20at%20Key%20Stage%203.pdf)

#### Digital skills curriculum

**Becoming a digital citizen at KS3**

* communicate using digital technology

**Becoming a digital worker at KS3**

* troubleshoot basic problems with their digital technology

[Read the full digital skills curriculum](https://ccea.org.uk/learning-resources/digital-skills-hub/key-stage-3-digital-skills-curriculum)

#### Mathematics and numeracy, statutory requirements, KS3

* develop knowledge and understanding of handling data
* knowledge and understanding of personal finance issues; and skills to enable competent and responsible financial decision making;
* the application of mathematical skills to real life and work situations;
* the creative use of technology to enhance mathematical understanding;
* demonstrate practical skills in using technology
* apply mathematical skills in everyday financial planning and decision making
* demonstrate financial capability in a range of relevant everyday contexts;
* research and manage information effectively to investigate and solve mathematical problems, using ICT where appropriate
* communicate effectively in oral, visual, written, mathematical and ICT formats, showing clear awareness of audience and purpose

[Read the full statutory requirements for mathematics and numeracy at KS3](https://ccea.org.uk/downloads/docs/ccea-asset/Curriculum/Statutory%20Requirements%20for%20Mathematics%20and%20Numeracy%3A%20Mathematics%20with%20Financial%20Capability%20at%20Key%20Stage%203.pdf)

## Curriculum for Wales

#### Science and technology

Progression step 2 - computation is the foundation for our digital world:

* I can safely use a range of tools, materials and equipment to construct for a variety of reasons
* I am beginning to explain the importance of accurate and reliable data to ensure a desired outcome
* I can follow instructions to build and control a physical device

Progression step 3 - computation is the foundation for our digital world:

* I can use sensors and actuators in systems that gather and process data about the systems’ environment

Progression step 4 - computation is the foundation for our digital world:

* I can select and use multiple sensors and actuators that allow computer systems to interact with the world around them.
* I can choose the most appropriate format for the storage and interrogation of data.
* I can make use of mathematical and logical operators in different software tools to investigate a line of inquiry independently.

Progression step 4 - being curious and searching for answers is essential to understanding and predicting phenomena:

* I can use my findings to draw valid conclusions.
* I can evaluate and identify ways of improving the reliability of data, taking anomalies into account.

Progression step 5 - - being curious and searching for answers is essential to understanding and predicting phenomena:

* I can critically evaluate the quality of data and justify improvements.

[Read the full science and technology curriculum](https://hwb.gov.wales/curriculum-for-wales/science-and-technology)

#### Humanities

Progression step 2 - Our natural world is diverse and dynamic, influenced by processes and human actions:

* I can describe how people and the natural world may impact on each other

Progression step 3 - Our natural world is diverse and dynamic, influenced by processes and human actions:

* I can describe and give simple explanations about the impact of human actions on the natural world in the past and present

[Read the full humanities curriculum](https://hwb.gov.wales/curriculum-for-wales/humanities/)

#### Mathematics and numeracy

Progression step 4 - Statistics represent data, probability models chance and both support informed inferences and decisions.

* I can make informed choices about how to organise and represent data, using a wide range of graphs and charts, including pie charts, frequency diagrams and frequency polygons.
* I can explore trends and anomalies in data sets, investigating correlation between two variables.
* I can use data to draw conclusions about hypotheses and I have communicated my findings clearly. I can critique my own methods and findings

Progression step 5 - Statistics represent data, probability models chance and both support informed inferences and decisions.

* I can critically analyse statistics, considering how data is represented, its reliability, and whether and how the data has been manipulated to tell a particular story. I can make informed decisions based on statistical evidence, identifying bias and anomalies.

[Read the full mathematics and numeracy curriculum](https://hwb.gov.wales/curriculum-for-wales/mathematics-and-numeracy/descriptions-of-learning/)

#### Digital competence framework

Progression step 1 - data and computational thinking - problem-solving and modelling:

* I can recognise and follow instructions in the appropriate order to perform a task.
* I can organise, select and use simple language to give instructions to others.
* I can control devices giving instructions.
* I can identify errors in simple sets of instructions (algorithm).

Progression step 2 - data and computational thinking - problem-solving and modelling:

* I can detect and correct mistakes which cause instructions (a solution) to fail (debug).
* I can create and record verbal, written and symbolic instructions to test ideas, e.g. the order of waking up through a diagram or flowchart.
* I can change instructions to achieve a different outcome.
* I can identify repetitions or loops in a sequence, e.g. identify where to shorten a set of instructions by repeating steps, for instance when learning a new song.

Progression step 3 - data and computational thinking - problem-solving and modelling:

* I can create and refine algorithms and flowcharts to solve problems, making use of features such as loops, Boolean values and formulae.
* I can understand the importance of the order of statements within algorithms.

Progression step 1 - data and computational thinking – data information literacy:

* I can collect data found in my environment.
* I can present and evaluate my data by creating simple charts, e.g. pictogram.

Progression step 2 - data and computational thinking – data information literacy:

* I can collect, enter, organise and analyse data into different groups or formats, e.g. tables, charts, databases and spreadsheets.
* I can extract and evaluate information from tables and graphs to answer questions.

Progression step 4 - data and computational thinking – data information literacy:

* I can perform analysis on simple data sets including grouping data as appropriate.

Progression step 5 - data and computational thinking – data information literacy:

* I can use appropriate programs to produce statistical evidence based on my own collected data/identified scenario and justify reasoning.
* I can use my data to explain and add validity to conclusions and, where possible, modify conclusions and/or hypothesis.

Progression step 1 - producing - evaluating and improving digital content:

* I can comment on work in relation to a single success criterion.

Progression step 2 - producing - evaluating and improving digital content:

* I can give an opinion about my own work and suggest improvements based on the success criteria.

[Read the digital competence framework](https://hwb.gov.wales/curriculum-for-wales/cross-curricular-skills-frameworks/digital-competence-framework)

## USA Code.org

**CS Fundamentals**

Courses C, D and E

Concepts included:

* events
* loops
* displaying data

[Read the full CS Fundamentals curriculum.](https://code.org/educate/curriculum/csf)

**CS Discoveries**

Units 1, 4, 5 and 6

Concepts included:

* problem solving
* inputs and outputs
* team project
* testing and acting on feedback
* sensors

[Read the full Code.org CS Discoveries curriculum](https://studio.code.org/courses/csd-2022)

## USA CSTA Standards

#### Grades 3-5

* 1B-CS-01 - Describe how internal and external parts of computing devices function to form a system.
* 1B-CS-02 - Model how computer hardware and software work together as a system to accomplish tasks
* 1B-CS-03 - Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies.
* 1B-DA-06 - Organize and present collected data visually to highlight relationships and support a claim.
* 1B-DA-07 - Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.
* 1B-AP-09 - Create programs that use variables to store and modify data.
* 1B-AP-10 - Create programs that include sequences, events, loops, and conditionals.

#### Grades 6-8

* Design projects that combine hardware and software components to collect and exchange data.
* Represent data using multiple encoding schemes.
* Collect data using computational tools and transform the data to make it more useful and reliable.
* Seek and incorporate feedback from team members and users to refine a solution that meets user needs.

[Read the CSTA Standards in full.](https://csteachers.org/Page/standardshttps://csteachers.org/k12standards/ )

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