

1. Year Groups

Year 3/4

2. Aspect of D&T

Electrical systems

Focus

Simple programming and control

3. Key learning in design and technology

Prior learning

- Constructed a simple series electrical circuit, using bulbs, batteries, switches and buzzers.
- Cut and joined a variety of construction materials, such as wood, card, plastic, reclaimed materials and glue.

Designing

- Gather information about users' needs and wants, and develop design criteria to inform the design of products that are fit for purpose.
- Generate, develop, model and communicate realistic ideas through discussion and, as appropriate, annotated sketches, cross-sectional and exploded diagrams.

Making

- Order the main stages of making.
- Select from and use tools and equipment to cut, shape, join and finish with some accuracy.
- Connect simple electrical components and a battery in a series circuit to achieve a functional outcome.
- Program a standalone control box, microcontroller or interface box to enhance the way the product works.

Evaluating

- Investigate and analyse a range of existing battery-powered products, including pre-programmed and programmable products.
- Evaluate their ideas and products against their own design criteria and identify the strengths and areas for improvement in their work.

Technical knowledge and understanding

- Understand and use computing to program and control products containing electrical systems, such as series circuits incorporating switches, bulbs and buzzers.
- Know and use technical vocabulary relevant to the project.

4. What could children design, make and evaluate?

illuminated sign noise-making toy vehicle
nightlight display lighting
other – specify

7. Links to topics and themes

Homes Travel and Holidays Cities
Emergency Vehicles School Business
Enterprise Light and Dark other – specify

5. Intended users

themselves younger children older children
teenagers parents shoppers friends
school general public other – specify

8. Possible contexts

home school leisure culture shops
enterprise environment sustainability
local community other – specify

6. Purpose of products

hobbies and interests utility pleasure
advertising comfort illumination
other – specify

9. Project title

Design, make and evaluate a _____ (product)
for _____ (user) for _____ (purpose)
To be completed by the teacher. Use the project title to set the scene for children's learning prior to activities in 10, 12 and 14.

11. Related learning in other subjects

- **Science** – know how to construct simple series circuits and have a basic understanding of conductors, insulators and open and closed switches.
- **Spoken language** – participate in discussion and evaluation of battery-powered, programmable products. Ask relevant questions to extend knowledge and understanding. Build their technical vocabulary.

13. Related learning in other subjects

- **Science** – know how to construct simple series circuits and have a basic understanding of conductors, insulators and open and closed switches.
- **Computing** – design, write and debug programs that accomplish specific goals, including controlling physical systems.
- **Spoken language** – asking questions to check understanding, develop technical vocabulary and build knowledge.

15. Related learning in other subjects

- **Spoken language** – maintain attention and participate actively in collaborative conversations, staying on topic and initiating and responding to comments. Develop understanding through speculating, hypothesising, imagining and exploring ideas.
- **Science** – know how to construct simple series circuits and have a basic understanding of conductors, insulators and open and closed switches.
- **Computing** – design, write and debug programs that accomplish specific goals, including controlling physical systems.
- **Art and design** – using and developing drawing skills.

16. Possible resources

microcontroller or a standalone control box or an interface box
collection of battery-powered, manually-controlled and programmable electrical products

different switches including toggle, push-to-make, push-to-break
plastic packaging, card, corrugated plastic, reclaimed materials, finishing media
output devices including buzzers, bulbs, bulb holders, LEDs, zinc carbon or zinc chloride batteries, battery holders, wire, automatic wire strippers right/left handed scissors, PVA glue, cutting mats

17. Key vocabulary

series circuit, fault, connection, toggle switch, push-to-make switch, push-to-break switch, battery, battery holder, light emitting diode (LED), bulb, bulb holder, USB cable, wire, insulator, conductor, crocodile clip

control, program, system, input device, output device, process

user, purpose, function, prototype, design criteria, innovative, appealing, design brief

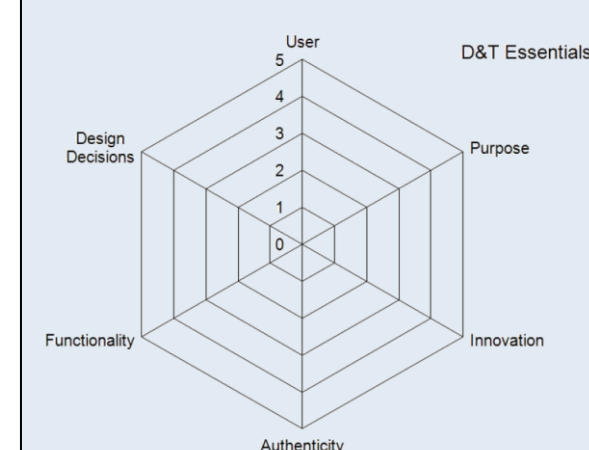
18. Key competencies

problem-solving teamwork negotiation
consumer awareness organisation motivation
persuasion leadership perseverance
other – specify

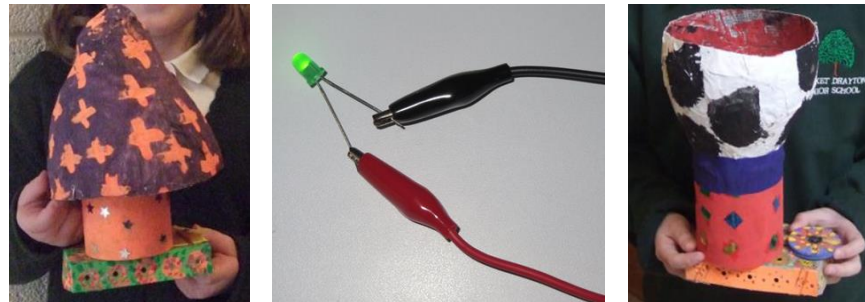
19. Health and safety

Pupils should be taught to work safely, using tools, equipment, materials, components and techniques appropriate to the task. Risk assessments should be carried out prior to undertaking this project.

20. Overall potential of project



Instant CPD



Tips for teachers

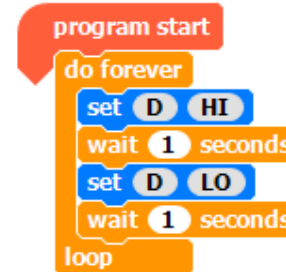
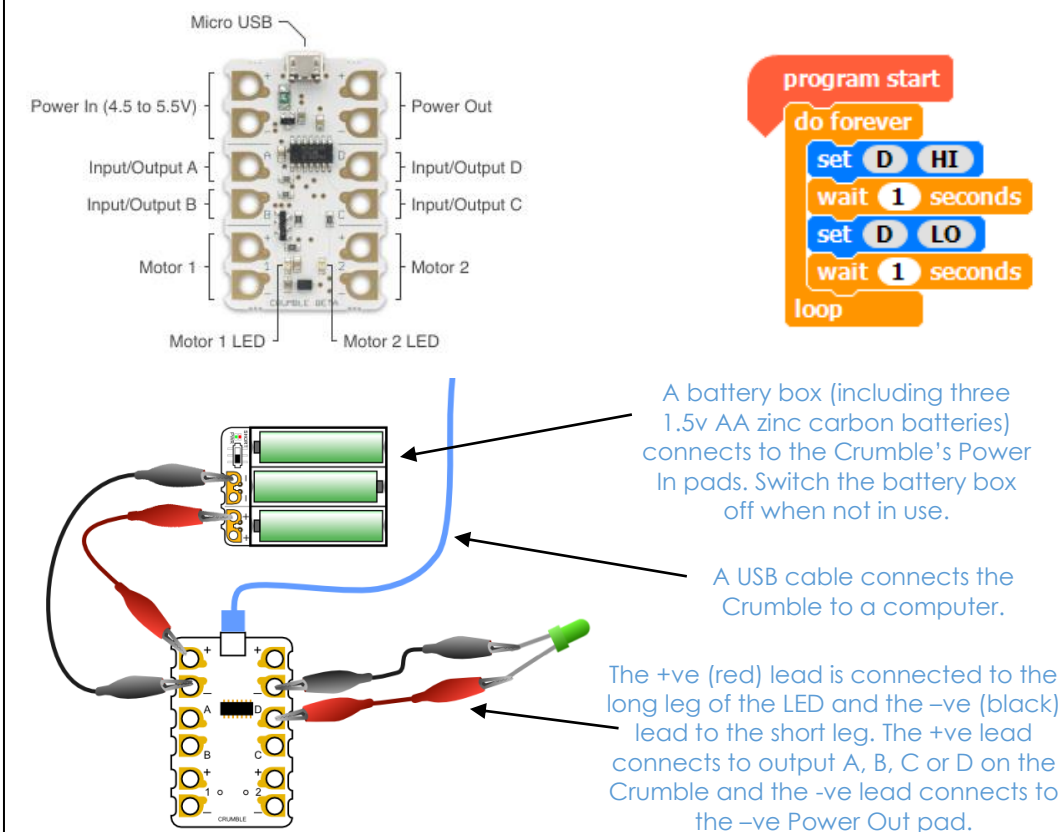
- ✓ Please also refer to the Instant CPD guidance in 'Year 3/4 Electrical systems – simple circuits and switches' when carrying out this project.
- ✓ Clean plastic drinks bottles or clear plastic packaging can be used to make housings for nightlights.
- ✓ Do this project around the same time or just after electricity is covered in science lessons.
- ✓ Build up a collection of battery-powered manual and programmable products, such as nightlights, for children to investigate and evaluate.
- ✓ Crocodile clips can be difficult for small fingers to manipulate. Stress the need for making secure connections.
- ✓ Set up a 'working' circuit so that children can test suspect components.
- ✓ Some components (e.g. buzzers and LEDs) need to be connected the right way round in a circuit, ensuring positive and negative match the poles of the interface box (e.g. FlowGo) or microcontroller (e.g. Crumble).
- ✓ Light emitting diodes (LEDs) with internal resistors should be used.
- ✓ Use 1.5v AA zinc carbon or zinc chloride batteries.
- ✓ Do not use alkaline, lithium or rechargeable batteries.
- ✓ Use Crumble-friendly battery boxes with a built-in resettable fuse to protect against short circuits.
- ✓ Teach children how to avoid making short circuits.
- ✓ CLEAPS recommend zinc carbon and zinc chloride batteries for Primary schools, not rechargeable, lithium or alkaline as these can overheat if short circuited. Button batteries are not recommended for younger children.

Useful resources at www.data.org.uk

- [Crumble kit suitable for KS2 and related guidance](#)
- [Primary Subject Leaders' File Sections 5.8 and 5.10](#)
- [Applying Computing in D&T at KS2 and KS3](#)
- [Torches, Lamps and Lanterns](#)
- [Developing Handmade Switches](#)
- [Night lights \(links to Literacy\)](#)
- [Handmade Switches Helpsheet](#)

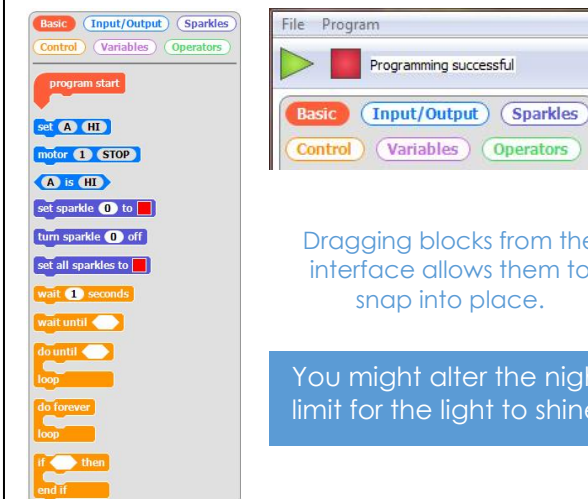
Connecting up a Crumble and an example program

This arrangement is for a nightlight or an illuminated sign that flashes on and off, using a light emitting diode (LED) as the output device.



Simple programming and control

Crumble drag and drop interface and menus



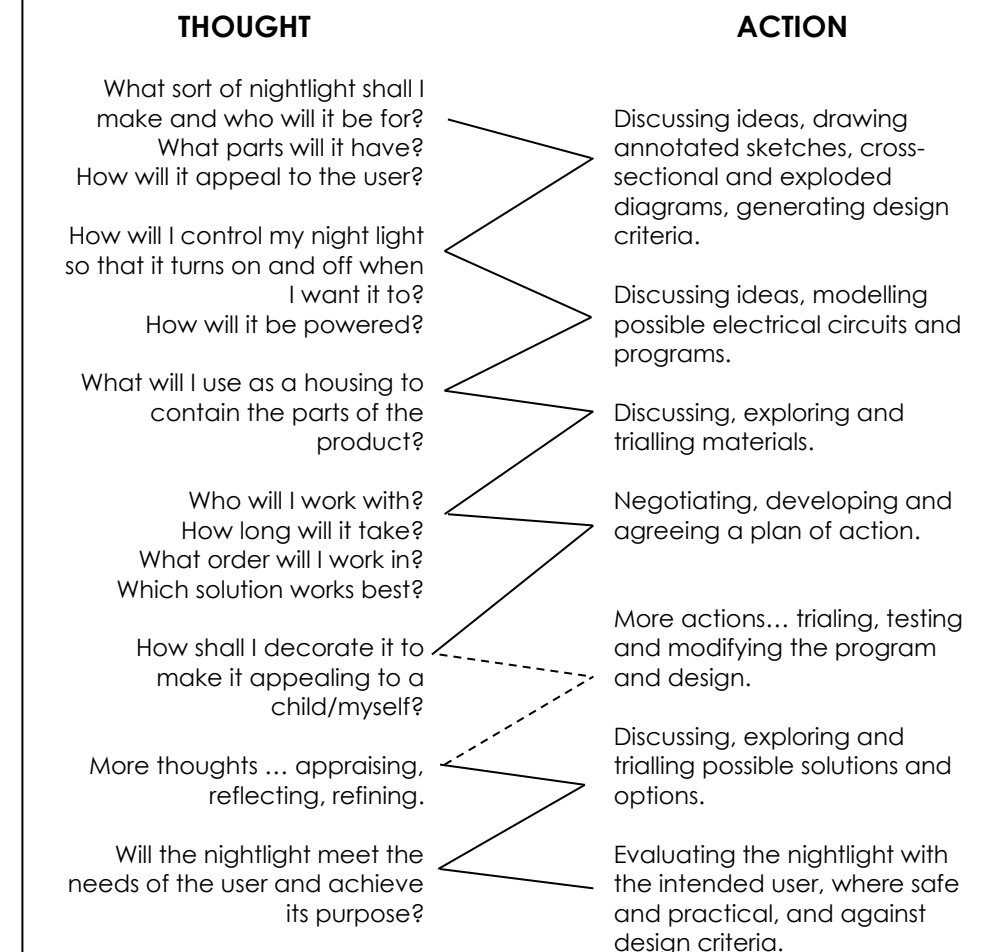
Control boxes and program ideas

An alternative to the Crumble or similar microcontrollers is a simple standalone control box or an interface box. Interface boxes sometimes use programming software in the form of flowcharts. Instructions and example programs can be easily found on the internet and adapted for use in products that children wish to design and make.



Designing, making and evaluating a personalised, programmable nightlight for themselves or another child

An iterative process is the relationship between a pupil's ideas and how they are communicated and clarified through activity. This is an example of how the iterative design and make process *might* be experienced by an individual pupil during this project:



Glossary

- **Program** – a sequence of instructions that can be used to control electrical components.
- **Microcontroller** – a device that can be programmed to control how an electrical product operates.
- **Light emitting diode (LED)** – an output device that glows when electricity is passed through it.
- **System** – a set of related parts or components that together achieve a desired outcome.
- **Output devices** – components that produce an outcome e.g. bulbs, motors and buzzers.
- **Input devices** – components that are used to control an electrical circuit e.g. switches.
- **Process** – how a computer program controls one or more output devices.