

1. Year Groups
Year
3/4

2. Aspect of D&T
Electrical systems
Focus
Simple circuits and switches

4. What could children design, make and evaluate?
siren for a toy vehicle reading light noise-making toy
nightlight illuminated sign torches table lamp
lighting for display hands-free head lamp
buzzer for school office other – specify

5. Intended users
themselves younger children older children
teenagers parents grandparents friends
school general public other – specify

6. Purpose of products
safety and security hobbies and interests
utility pleasure advertising gift
energy saving for sale other – specify

16. Possible resources
handling collection of battery-powered electrical products
switches including toggle, push-to-make and push-to-break

17. Key vocabulary
series circuit, fault, connection, toggle switch, push-to-make switch, push-to-break switch, battery, battery holder, bulb, bulb holder, wire, insulator, conductor, crocodile clip

7. Links to topics and themes
Homes Travel and Holidays Cities
Emergency Vehicles School Business
Enterprise Light and Dark other – specify

8. Possible contexts
home school leisure culture
enterprise environment sustainability
local community 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.

aluminium foil, paper fasteners, paper clips, card, corrugated plastic, reclaimed materials, finishing materials and media

buzzers, bulbs, bulb holders, batteries, battery holders, wire, automatic wire strippers
suitable control program with interface box or standalone control box
right/left handed scissors, PVA glue, cutting mats

control, program, system, input device, output device

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

3. Key learning in design and technology

Prior learning
• Constructed a simple series electrical circuit in science, using bulbs, switches and buzzers.

• Cut and joined a variety of construction materials, such as wood, card, plastic, reclaimed materials and glue.

Designing
• Gather information about needs and wants, and develop design criteria to inform the design of products that are fit for purpose, aimed at particular individuals or groups.
• 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.
• Select from and use materials and components, including construction materials and electrical components according to their functional properties and aesthetic qualities.

Evaluating
• Investigate and analyse a range of existing battery-powered 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 electrical systems in their products, such as series circuits incorporating switches, bulbs and buzzers.
• Apply their understanding of computing to program and control their products.
• Know and use technical vocabulary relevant to the project.

10. Investigative and Evaluative Activities (IEAs)
• Discuss, investigate and, where practical, disassemble different examples of relevant battery-powered products, including those which are commercially available e.g. *Where and why they are used? How does the product work? What are its key features and components? How does the switch work? Is the product manually controlled or controlled by a computer? What materials have been used and why? How is it suited to its intended user and purpose?*
• Ask children to investigate examples of switches, including those which are commercially available, which work in different ways e.g. push-to-make, push-to-break, toggle switch. Let the children use them in simple circuits e.g. *How might different types of switches be useful in different types of products?*
• Remind children about the dangers of mains electricity.

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 products. Ask relevant questions to extend knowledge and understanding. Build their technical vocabulary.

12. Focused Tasks (FTs)
• Recap with the children how to make manually controlled, simple series circuits with batteries and different types of switches, bulbs and buzzers. Discuss which of the components in the circuit are input devices e.g. switches, and which are output devices e.g. bulbs and buzzers.
• Demonstrate how to find a fault in a simple circuit and correct it, giving pupils opportunities to practise.
• Use a simple computer control program with an interface box or standalone control box to physically control output devices e.g. bulbs and buzzers.
• Ask the children to make a variety of switches by using simple classroom materials e.g. card, corrugated plastic, aluminium foil, paper fasteners and paper clips. Encourage children to make switches that operate in different ways e.g. when you press them, when you turn them, when you push them from side to side. Ask the children to test their switches in a simple series circuit.
• Teach children how to avoid making short circuits.

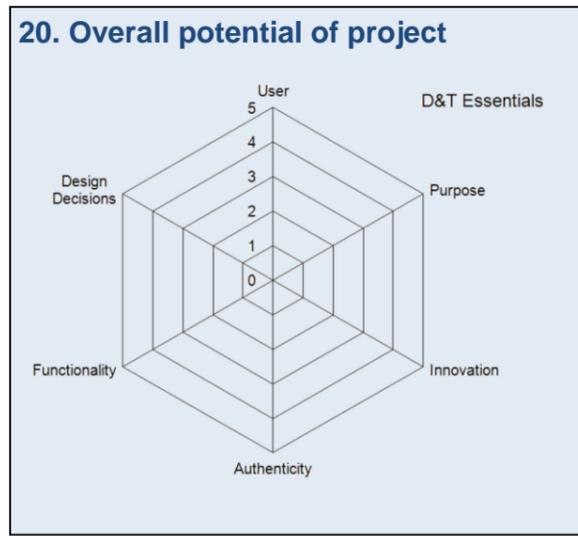
13. Related learning in other subjects
• **Science** – know how to construct simple series circuits and have a basic understanding of conductors, insulators and open and closed switches.
• **Computing** – design, write and debug programs that accomplish specific goals, including controlling physical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

14. Design, Make and Evaluate Assignment (DMEA)
• Develop a design brief with the children within a context which is authentic and meaningful.
• Discuss with children the purpose of the battery-powered products that they will be designing and making and who they will be for. Ask the children to generate a range of ideas, encouraging realistic responses. Agree on design criteria that can be used to guide the development and evaluation of the children's products, including safety features.
• Using annotated sketches, cross-sectional and exploded diagrams, as appropriate, ask the children to develop, model and communicate their ideas.
• Ask the children to consider the main stages in making and testing before assembling high quality products, drawing on the knowledge, understanding and skills learnt through IEAs and FTs.
• Evaluate throughout and the final products against the intended purpose and with the intended user, drawing on the design criteria previously agreed.

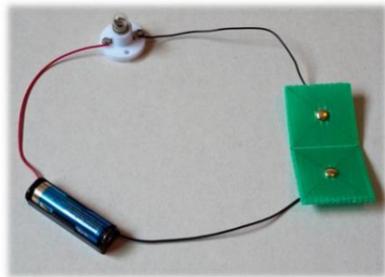
15. Related learning in other subjects
• **Spoken language** – maintain attention and participate actively in collaborative conversations, staying on topic and initiating and responding to comments. Develop understanding through speculating, hypothesising, imagining and exploring ideas.
• **Science** – 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.

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.



Instant CPD



Tips for teachers

- ✓ This project should be undertaken either around the same time or soon after electricity is covered in science.
- ✓ Use a selection of images of existing battery-powered products to add to the actual products that children investigate and evaluate.
- ✓ Check the condition of the batteries prior to activities.
- ✓ Stress the need for making secure connections.
- ✓ To reduce the number of requests for help, model the fault-finding process: check all the connections, ensure that bulbs are screwed in tightly and ensure that components are correctly connected.
- ✓ Have a 'working' circuit set up so that children can test suspect components.
- ✓ Some components (e.g. buzzers) need to be connected the right way round in a circuit, ensuring positive and negative match the poles of the battery.
- ✓ Make sure bulbs and batteries match e.g. 1.5v bulb with a 1.5v battery.
- ✓ Do not use rechargeable batteries.

Useful resources from www.data.org.uk

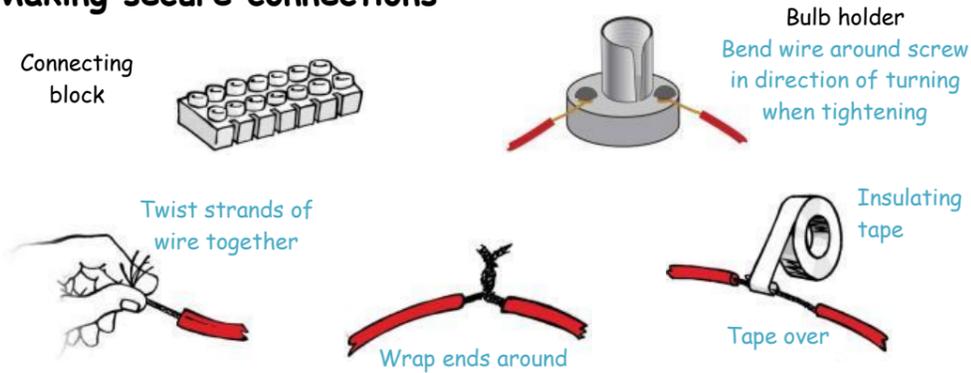
- Torches, Lamps and Lanterns
- Night Lights
- Developing Handmade Switches
- CPD Resources Primary Inset Guides

D&T Association publications:

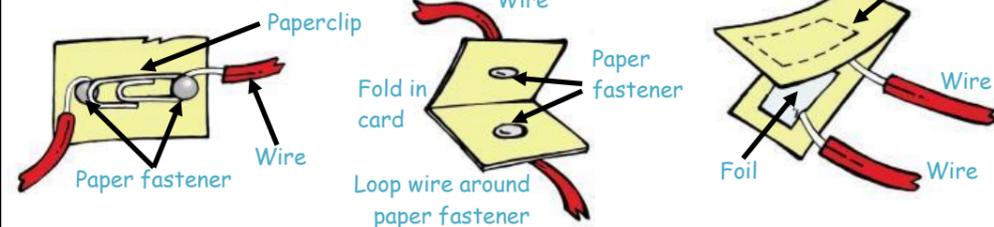
- Primary Helpsheets - Units 4C, 4D, 4E
- Primary Lesson Plans - Units 4C, 4D, 4E

Please note that these publications are based on previous National Curricula.

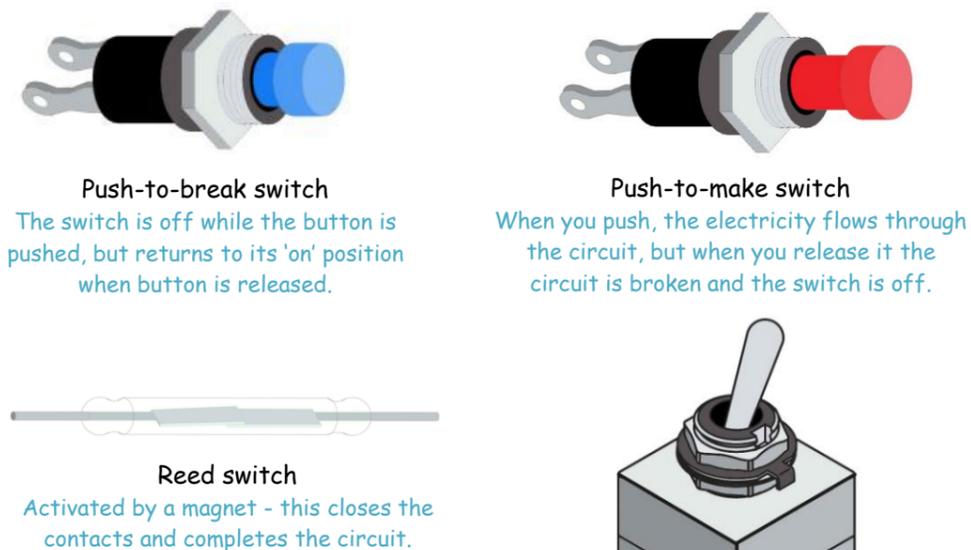
Making secure connections



Handmade switches



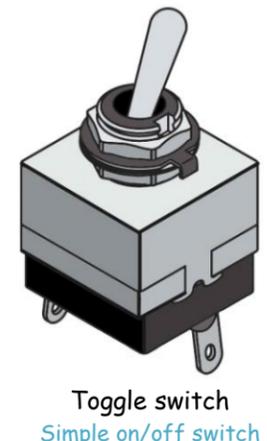
Commercial switches



Standalone control box



When children are familiar with using electrical circuits they should be introduced to a simple standalone control box or an interface box. The box will replace their switches and battery, and children can program their product to work automatically.



Designing, making and evaluating a night light for a brother, sister or friend

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:

THOUGHT	ACTION
What sort of night light shall I make and who will it be for? What parts will it have? How will it appeal to the user?	Discussing ideas, drawing annotated sketches, cross-sectional and exploded diagrams, generating design criteria
What switch will work best for my night light? How will I make the base, casing and shade?	Discussing ideas, modeling possible electrical circuits
Who will I work with? How long will it take? What order will I work in?	Discussing, exploring and trialling materials
More thoughts... appraising, reflecting, refining	Negotiating, developing and agreeing a plan of action
More thoughts... appraising, reflecting, refining	More actions... assembling, testing, modifying
Will the night light meet the needs of the user and achieve its purpose?	More actions... assembling, testing, modifying Evaluating the nightlight with the intended user and against design criteria

Glossary

- Circuit** - path through which electricity passes.
- Conductor** - a material which allows an electric current to pass through it.
- Insulator** - a material which does not easily allow electric current to pass through it.
- Prototype** - a model made to test whether a design will work.
- Push-to-break switch** - a switch turned off by pressing it.
- Push-to-make switch** - a switch turned on by pressing it.
- Reed switch** - a switch operated by a magnet.
- Toggle switch** - a switch operated when a lever is pressed.
- System** - a set of related parts or components that together achieve a desired outcome.
- Output devices** - components that produce an outcome e.g. bulbs and buzzers.
- Input devices** - components that are used to control an electrical circuit e.g. switches.

