

Year 4 Planning
DESIGN AND TECHNOLOGY
Electrical Systems – Circuits and Switches
 Understand and use electrical systems in products

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
- **NOTE – THIS PROJECT SHOULD BE UNDERTAKEN EITHER AROUND THE SAME TIME OR SOON AFTER ELECTRICITY IS COVERED IN SCIENCE**

Lesson 1 - TECHNICAL KNOWLEDGE/MAKE SKILL KNOWLEDGE RECORDED IN KEY SKILLS BOOKS
WALT: Understand how to make a manually controlled, simple series circuits

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 control, program, system, input device, output device user, purpose, function, prototype, design criteria, innovative, appealing, design brief.*

TYPES OF ELECTRICAL SYSTEM
 Show children a collection of battery-powered manual and programmable products, such as a noise-making toy, and discuss with the children how their electrical components work.

MAKING SECURE CONNECTIONS - FOCUSED TASKS (FTs)
 Recap with children how to make manually controlled, simple series circuits with batteries and different types of switches, bulbs and buzzers. Revise the symbols for each component. Discuss which of the components in the circuit are input devices e.g.

Lesson 2 – EVALUATING COMPLETE PAGES 2-3 FROM ACCOMPANYING BOOKLET
WALT: Investigate and analyse a range of existing products

INVESTIGATIVE AND EVALUATIVE ACTIVITIES (IEAS)
 Investigate and evaluate a range of existing products.

EVALUATING BATTERY-POWERED PRODUCTS
 Use a selection of images of existing battery-powered products alongside actual products for the children to begin investigating in their groups.

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?*

Lesson 3 - DESIGNING COMPLETE PAGE 4 FROM ACCOMPANYING BOOKLET
WALT: Develop a design criteria to inform the design of a product

CARRY OUT RESEARCH
 Get children to gather information about needs and wants of a particular audience by completing a survey, interview or questionnaire in order to develop a design specification for their product.

- Purpose of the product
- Intended Users
- Popular themes
- Context of product

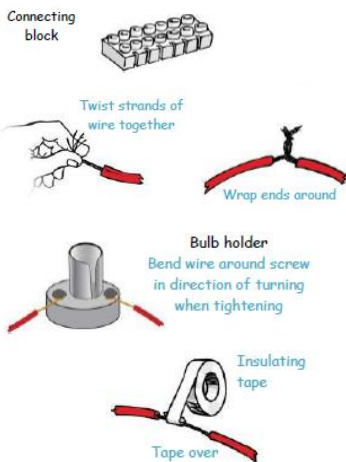
Children must carefully consider the purpose and intended user for their product.
LINKED TO 3RD HOUR ACTIVITY

CREATING A DESIGN BRIEF
 Discuss with the children the purpose of a battery-powered, programmable products that they will be designing and making and who they will be for. In groups, ask children to generate a range of ideas on what they could design, make and evaluate, encouraging realistic responses. **[talk-less teaching strategy]**, e.g. *siren for a toy vehicle, nightlight, reading light, lighting for display, buzzer*

switches, and which are output devices e.g. bulbs and buzzers.

Next, demonstrate how to find a fault in a simple circuit and correct it. Give pupils opportunities to practise in their groups making the different secure connections outlined below. Model the fault-finding process: *check all the connections, ensure that bulbs are screwed in tightly, ensure that components are correctly connected.*

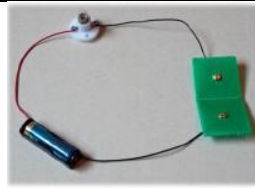
Making secure connections



Ask children to draw a faulty circuit in their key skills books recording why there is no connection and how to check for faults.

SWITCHES

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.



Ask children to draw an existing product, annotating it to show electrical components and how it works. Alternatively, children could take photographs of the product and annotate (see page 2).

INVESTIGATE SWITCHES

Pose the following question: *How might different types of switches be used in different types of products?* Ask children to investigate examples of the different switches on the products, 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.



Toggle switch
Simple on/off switch

Commercial switches



Push-to-break switch
The switch is off while the button is pushed, but returns to its 'on' position when button is released.



Push-to-make switch
When you push, the electricity flows through the circuit, but when you release it the circuit is broken and the switch is off.

for school office. (see page 4 of booklet for a detailed list)..

What sort electrical product should I make? What parts will it have? How will it appeal to the user? How will I make the base, casing and shade?

THE DESIGN BRIEF

Now model how to develop an authentic and meaningful design brief with the children based on their research - this should consist of no more than seven criteria their product must meet e.g. the product was be weather proof.

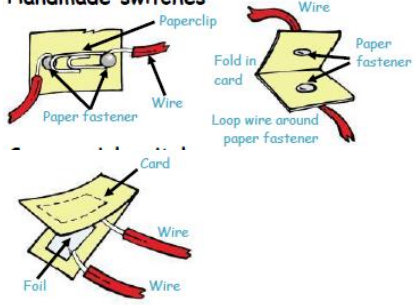
Show children examples of design briefs for products and explain that the design brief must concentrate on design outcomes (like size, function) not specific product details (like colour).

The design brief will allow children to focus on the problem they are solving and what they are trying to achieve from the product.

Agree on a design criteria that can be used to guide the development and evaluation of the children's products, including safety features. Develop a project title from the results:

Design, make and evaluate a _____ (product) for _____ (user) for _____ (purpose).

EDWARD DE BONO THINKING HATS

<p>Handmade switches</p>  <p>Ask children to draw diagrams of their hand-made switches into their key skills books. Attach example switches to PAGE 1 of the accompanying booklet. <i>Continue in Science if unable to complete.</i></p>	<p>Next, ask children to record answers to these questions against Edward De Bono Thinking Hats. Explain what each hat represents [page 3]</p> <ul style="list-style-type: none"> - WHITE: Facts - RED: Feelings - BLACK: Problems - GREEN: Creativity - YELLOW: Benefits - BLUE: Process <p>Encourage children to look for different types of electrical circuits in the home and in school. Children could print images from the internet to add to their 'mood' board and annotate.</p>	
<p>Lesson 4 - TECHNICAL KNOWLEDGE/MAKE KNOWLEDGE TO BE RECORDED IN KEY SKILLS BOOKS</p> <p>WALT: Program and control products using simple computer software</p> <p>LAPTOPS OR COMPUTERS RUNNING THE CRUBLE SOFTWARE WILL BE REQUIRED</p> <p>Explain that today we will be applying our understanding of computing to program their product to work automatically.</p> <p>FOCUSED TASKS (FTs)</p> <p>Now children are familiar with using electrical circuits they should now be introduced to a simple standalone control box. Model how to use this simple computer control program to physically control output devices. The box will replace their battery and switches, and children can</p>	<p>Lesson 5 - DESIGNING COMPLETE PAGES 5-6 FROM ACCOMPANYING BOOKLET</p> <p>WALT: Generate innovative ideas through annotated sketches</p> <p>In this lesson, model how to communicate ideas through detailed, annotated sketches.</p> <p>WORKING DRAWINGS</p> <p>Ask children to create annotated sketches and cross-sectional diagrams to communicate their product ideas. The drawings should indicate the design decisions made, including the location of the components, how they work as a system, materials, dimensions, and the appearance and finishing techniques for the product. Children annotate their working drawing explaining their thought process and techniques.</p> <p>Children to consider the following questions:</p>	<p>Lesson 6 – MAKING COMPLETE PAGES 7-9 FROM ACCOMPANYING BOOKLET</p> <p>WALT: Order the main stages of making</p> <p>MAKING A PROTOTYPE</p> <p>Ask children to consider the following questions when making their prototype:</p> <ul style="list-style-type: none"> - <i>What tools and electrical components will I need?</i> - <i>What output and input devices do I need?</i> - <i>What constraints am I working to?</i> - <i>What switch will I use?</i> - <i>Will my product meet the needs, wants and interests of the user group?</i> - <i>How will it address a problem or need?</i> <p>Applying their knowledge, understanding and skills from Focused Tasks (FTs), children should make a high quality prototype using simple</p>

program their product to work automatically.

Standalone control box



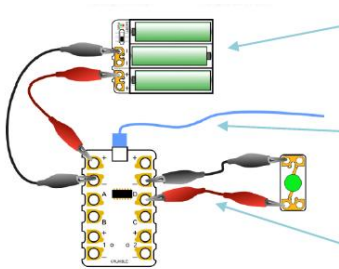
SIMPLE PROGRAMMING AND CONTROL

Have the children write, test and debug programs that will control the electrical product they have made for a clearly defined purpose by getting them to discuss in groups the function of their product, e.g. bulb on a nightlight switching off after a period of time or LEDs flashing on and off to illuminate a sign in a shop window.

USING 'CRUMBLE'

[THIS SKILL COULD BE TAUGHT IN ICT KEY SKILLS]

Introduce pupils to the Crumble program inspired by MIT Scratch and model how connect the components and use the drag and drop interface.



The pupils connect a Crumble interface to a light dependent resistor (LDR) and to the bulbs or LEDs in their products, and apply their understanding of computing to program, monitor and control their products.

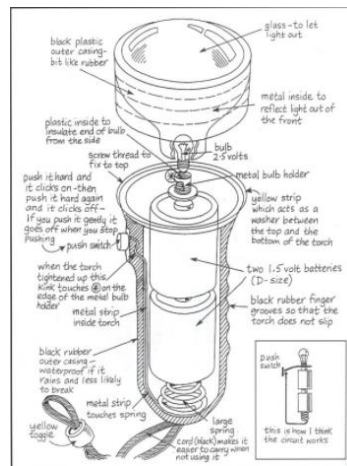
- Which materials will I use to make it?
- How will I make it fit for purpose?

USING COMPUTER-AIDED DESIGN

Extend children to develop their computer-aided design (CAD) skills by using such as Techsoft 2D Primary or Microsoft Word to generate and modify appearance and finishing techniques for the product. Children should recognise that designs can be easily modified and repeated on the computer without the need for a physical product.

EXPLODED DIAGRAMS

Show children some examples of exploded diagrams. Ask children to draw an example of their product showing the parts separated, but in the correct relationship for fitting together.



classroom materials. It should contain **simple electrical components** and an element of **computer programming** to achieve a functional outcome.



Example prototype for a torch

RECORD THE MAKE

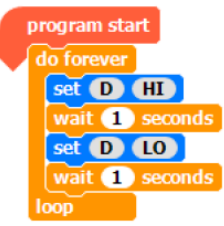
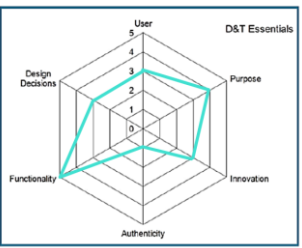
Ask children to consider the main stages in making and testing before assembling a high quality product in the application weeks. They must draw on their knowledge, understanding and skills learnt through IEAs and FTs. Children should produce a detailed, step-by-step plan, listing tools and materials. Children can take photographs at each stage of the make [see page 7 of booklet].

Children should also record their programming instructions from **LESSON 4**.

CRITICALLY EVALUATE THE DESIGN

Encourage children not to be afraid to include any failed designs into displays of final products. Include evaluations of why the designs didn't work and how children would make them work. This links to design in the real world and the concept that designs don't always work first time around.

Discuss the model below and key terminology [REFER TO PAGE 14 in booklet]. Show children how to evaluate against the six essential

 <p>Get children to record their list of instructions that Crumble will follow in their Key Skills books.</p> <p><i>*Note: Instructions and example programs on how to use the 'Crumble' interface can easily be found on the internet.*</i></p> <p>TIPS</p> <ul style="list-style-type: none"> ✓ Light emitting diodes (LEDs) with internal resistors should be used. ✓ Use 1.5v AA zinc carbon or zinc chloride batteries ✓ Use Crumble-friendly battery boxes with a built-in resettable fuse to protect against short circuits. ✓ Make sure bulbs and batteries match e.g. 1.5v bulb with a 1.5v battery. ✓ Do not use rechargeable batteries. 	<p><i>Example products using an electrical system</i></p>	<p>characteristics by giving it a score from 0-5, with 0 being the lowest score.</p> 
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Note:

One Project booklet is required per child for the entire 6-week unit. Preferably A3 size.

During the first 3 weeks of the modelling teaching sequence, children will complete the first half of their booklet outlined in the plans above. When creating the design brief and communication of ideas, children must decide in their groups on a product they would like to manufacture.

Lesson 6 requires children to make a prototype of their chosen design using materials and skills gained from focused tasks (FTs).

Throughout the application weeks, children will work in their groups and complete the second half of their project booklet [pages 10-15]. Outlined below are the tasks children are required to complete.

Application of Skill

TASK SHEET

Electrical Systems – Circuits and Switches

Understand and use electrical systems in products

1. Make a high quality product, applying knowledge, understanding and skills from IEAs and FTs. **Make a product with an electrical system.** Include a photograph and drawing of the finished product. [page 11-12]
2. Compare the final product to the original design specification. [page 12]
3. Test products with the intended user, where safe and practical [page 13]
4. Critically evaluate the quality of the design, manufacture, functionality and fitness for purpose. [page 14]
5. Consider the views of others to improve your work using Thinking Hats [page 15]
6. **ENGLISH TASK - Research about the dangers of electricity and produce a safety poster.**