

## Unit 7D Using control to control a display

### Focus: control and structures

#### About the unit

The main aim of this unit is for pupils to learn how to apply and combine their understanding of electrical and mechanical control and structures when designing and making. They can also develop and practise graphic communication techniques.

In this unit, pupils tackle a design and make assignment (DMA) on the theme 'Point-of-sale display', in which they produce an eye-catching display that communicates clearly and uses simple control of movement, light or sound.

Pupils gain the knowledge, skills and understanding they need to carry out the DMA successfully through product evaluation activities and focused practical tasks. They:

- model, design and construct simple electrical control circuits that include switches and outputs in parallel and series, protection of LEDs and reversing control of motors
- classify motion into four kinds and describe mechanisms that can be used to change one kind of motion into another
- use cams and linkages to create a particular kind of motion
- design and carry out fair tests to compare the strength of frame and sheet structures
- design and make structures that are strong, using their knowledge of structural strength
- consider different approaches to product marketing

There are also opportunities for pupils to:

- solder components and wires together effectively and safely when constructing simple electrical control circuits
- use a range of graphic techniques to create lettering and recognise their relative merits in different situations
- select appropriate lettering styles for a particular purpose
- use levers to change the amount and force of a movement in a planned way
- use CAD/CAM (computer-aided design and manufacture), where appropriate, to produce high-quality lettering and other graphics, *eg logos*

#### Where the unit fits in

This unit is expected to take 15–24 hours.

This is one of three units that focus on using control: this one in year 7 on using electrical and mechanical control to control a display; one in year 8 on programming a computer-based controller when using control for security; and one in year 9 on designing and making electronic circuits for control when using control for electronic monitoring. (There is an option to introduce microcontrollers in year 9.) These units ensure progression in understanding a range of control technologies and their use in designing and making.

It is expected that pupils in all years will go beyond simply ensuring that control technologies work to designing, modelling and making products that incorporate control. This means there are opportunities to develop pupils' skills in both resistant materials and control.

This unit includes work on designing and making strong structures. There is also an opportunity to teach graphic skills, *eg lettering*, that can be applied when working with different materials.

If you choose not to teach this unit, then plan to include the essential activities identified by the symbol ■ as part of another unit.

If this unit is used later in year 7, then pupils should be able to complete more of the optional activities. Teachers may find it helpful to use the unit as an end-of-year project, to bring together knowledge and develop group skills.

#### Expectations

##### At the end of this unit

**most pupils will:** draw on and use their understanding of electrical control, including the use of switches and the control of motors; work with a range of tools, equipment, materials and components, including electrical and mechanical control components, with some precision; draw on and use their understanding of motion and mechanisms, including cams, linkages and levers; draw on and use their understanding of structural design and strength for both frame and sheet structures; test and evaluate their product, showing that they understand the situation in which their design will have to function; produce a finished promotional display that is eye-catching, works as planned, combines materials realistically, informs, promotes the product in an appropriate way and reflects a group contribution; choose appropriately from a range of graphic elements and lettering

**some pupils will not have made so much progress and will:** work with some mechanical components, including cams, linkages and levers; work with some electrical components, including switches and motors; use frame and sheet structural elements; produce lettering for a particular purpose; produce a promotional display that is suited to its purpose, recognising what works well

**some pupils will have progressed further and will:** make effective use of CAD/CAM to produce high-quality lettering and other graphics, *eg logos*; use modelling software to support the design of their control system, modifying their approach in the light of progress; produce a finished promotional display that is innovative and works effectively

- essential activities
- optional activities

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## Prior learning

It is helpful if pupils have:

- learnt that differently shaped cams produce different movements
- explored the relationship between a cam and a follower
- considered the characteristics of a cam mechanism when designing
- tested mechanisms and made adjustments, where necessary
- learnt how structures can fail when loaded and used techniques for reinforcing and strengthening them
- modelled ideas for their own product using mechanisms, by using construction kits or making a model from a set of instructions
- included an electric motor in a simple circuit
- learnt that there are different sorts of switches
- controlled the speed and direction of movement using pulleys and/or gears
- used simple electrical circuits with switches to achieve functional results

Pupils should have gained the above knowledge, skills and understanding in years 5 and 6, through unit 5C ‘Moving toys’, unit 6A ‘Shelters’, unit 6C ‘Fairground’ and unit 6D ‘Controllable vehicles’ in the key stage 2 scheme of work, or similar projects.

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## Language for learning

Through the activities in this unit, pupils will be able to understand, use and spell correctly words relating to:

- structures and structural elements, *eg force, load, compression, tension, strut, tie, reinforcement, pin joint*
- electrical components and their assembly, *eg electrical, series, parallel, light-emitting diode, LED, resistor, current, sensor, output, solder, soldering iron*
- mechanical components and their assembly, *eg mechanical, gear, axle, cam, follower, linkage, pulley, belt, drive, rotary, linear, reciprocating, oscillating*

Speaking and listening – through the activities pupils could:

- organise, sequence and link what they say so listeners can follow it
- identify the main points of a talk, TV programme, etc
- share information and discuss ideas in groups, and solve problems

Reading – through the activities pupils could:

- follow the sequence of actions, processes or ideas being described

Writing – through the activities pupils could:

- avoid common errors and confusions

Vocabulary and spelling – through the activities pupils could:

- understand and use correctly terms of qualification and comparison

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## Resources

Resources include:

- materials for making sheet and frame structures and mechanical elements, *eg cams, levers, linkages*
- sheet and frame samples for structural testing
- mechanical components, *eg gears, axles*
- electrical components, *eg copper tape, LEDs, motors, buzzers, switches, resistors, wire*
- equipment for modelling electrical circuits, *eg mounted components, modelling software*
- soldering equipment, *eg irons, stands, solder, tools, connection blocks*
- computers for running a control program, CAD (computer-aided design), CAM (computer-aided manufacture)
- useful websites, *eg*
  - [www.howstuffworks.com/microcontroller.htm](http://www.howstuffworks.com/microcontroller.htm)
  - [www.dtonline.org/apps/menu/app.exe?2&1&0](http://www.dtonline.org/apps/menu/app.exe?2&1&0)
  - [www.users.dircon.co.uk/~doctron/](http://www.users.dircon.co.uk/~doctron/)
  - [www.o2.org](http://www.o2.org)

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## Future learning

Pupils could go on to further systems and control units, *eg unit 8D ‘Using control for security’, unit 9D ‘Using control for electronic monitoring’.*

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## Out-of-school activities and homework

Pupils could:

- carry out a survey of shop displays
- collect examples of different approaches to advertising, to discuss in class
- investigate the input devices used in a range of products
- collect information on aspects of relevance to product marketing

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## Links with other subjects

- Science: unit 7J ‘Electrical circuits’ – recognising the purpose of simple electrical control elements when testing and evaluating an electrical system, and unit 7K ‘Forces and their effects’ in the science scheme of work.
- ICT: graphics, CAD, CAM, electrical modelling.
- Mathematics: collecting data and displaying it, drawing and modelling ideas in 2-D and 3-D.
- English: reporting on research findings, writing advertising copy.
- Art and design: graphic design.
- Business and economics: marketing.

**Learning objectives**

Pupils should learn:

**Possible teaching activities****Learning outcomes**

Pupils:

**Points to note****DESIGN AND MAKE ASSIGNMENT (DMA)**

- to design a product that uses a range of technologies, including simple control, to meet a specific purpose, by applying the knowledge, skills and understanding they developed during the product evaluation activities and focused practical tasks

Set the pupils a DMA that requires them to bring together their knowledge, skills and understanding of electrical and mechanical control and structures to meet a specific and appropriate purpose.

**Example**

This example DMA has been written so it can be copied and given directly to pupils. Further details and contexts can be added, as appropriate.

**Point-of-sale display**

Point-of-sale displays, especially for new or seasonal products, are becoming increasingly sophisticated and attractive. Their design is constrained in a number of ways, *eg they need to be cheap yet robust, to stand up safely to wear and tear without the need for supervision or constant maintenance, to be prominent without getting in the way of customers.*

Design an attractive, original and active or moving point-of-sale display to be placed somewhere in a shop or supermarket, *eg on a shelf*. The display can be for a real or imaginary new product or service. You might like to design a display that supports a charity or another cause you are interested in. You may work as part of a team during this assignment.

- work in a group, using a range of materials to create their display
- keep a log of their part in the team's work, like professional designers
- design an attractive, original, active display for a product or service
- research the background to the product or service
- select appropriate images and suitable materials to promote the product or service
- discuss how the display will be seen
- suggest different materials and ways of working
- discuss, draw and model ideas in 2-D and 3-D
- discuss, as a group, how to use output devices and sensors in their design
- experiment with alternative designs, model circuits and mechanisms to establish correct working before deciding on their final proposal
- prepare an ordered sequence for managing the task
- combine various materials into an eye-catching, active display which will attract their chosen audience

**Language for learning when planning for making**

- Ask pupils to work in small groups and look at sequences in text, flow charts and tables, and:
  - reorder from random to the correct order
  - complete gaps in processes and sequences

**Language for learning when keeping records**

- Ask pupils to keep a record of their project through logs, diaries, folios and sketchbooks, having been told what is expected, the conventions of what to record and how to record it. As a group, pupils could look at each others' records, identifying criteria for a good record of work.

**Language for learning when producing graphics**

- Ask pupils to explore the way displays use language and make explicit links, *eg word association with image.*

■ essential activities


○ optional activities

Pupils should learn:

Pupils:

## PRODUCT EVALUATION

- Organise a range of activities that give pupils an opportunity to:
- examine and evaluate the working of simple electrically and mechanically controlled products that could be used for point-of-sale displays
  - examine, describe and evaluate how products are marketed at the point of sale

<ul style="list-style-type: none"> <li>■ to recognise and understand the purpose of simple electrical and mechanical control elements in existing products, <i>eg switches, sensors, buzzers, motors, lamps, LEDs, gears, cams, pulleys, card mechanisms</i></li> </ul>	<ul style="list-style-type: none"> <li>■ Ask the pupils to examine and disassemble existing graphic-based products that include control, <i>eg electronic greeting cards, pop-up cards and books, products with membrane switches</i>. Ask them to identify technical components, <i>eg input sensors, switches, output devices and mechanisms, including card mechanisms</i>. Discuss with the pupils materials that have been used.</li> </ul>	<ul style="list-style-type: none"> <li>■ describe the electrical components used in the product and explain what they do, <i>eg how the switch connects the circuit in an electronic greeting card</i></li> <li>■ describe the mechanical components used in the product and explain what they do, <i>eg how a card lever in a pop-up book creates an effect</i></li> </ul>	<p> <b>Health and safety</b> – care should be taken to ensure that pupils assess immediate risks when carrying out product evaluation activities, <i>eg teachers should give clear information and supervise activities if products have sharp edges or pointed elements</i></p>
<ul style="list-style-type: none"> <li>■ to consider the relative merits of the different approaches used to market products, <i>eg use of colour, contrast, graphics, product identity, movement, sound, lighting</i></li> </ul>	<ul style="list-style-type: none"> <li>■ Ask the pupils to carry out a survey of window displays in local or city shops, sketching the content of the displays and recording the dimensions of display surface areas. Ask them to compare and contrast similar and different shops.</li> </ul>	<ul style="list-style-type: none"> <li>■ suggest different approaches to point-of-sale marketing in a particular situation, giving advantages and disadvantages</li> </ul>	<p><b>Language for learning when identifying opportunities</b></p> <ul style="list-style-type: none"> <li>• Give groups of four or five pupils a situation, and after discussion and planning ask each group to give a three-minute presentation to the class on opportunities for, and approaches to, point-of-sale marketing. Their presentation could include:           <ul style="list-style-type: none"> <li>– an introduction</li> <li>– opportunities (pros and cons)</li> <li>– approaches (pros and cons)</li> <li>– recommendations or best guess</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>○ to identify the opportunities for, and constraints on, product marketing at the point of sale, <i>eg shop windows, counters, cabinets, wall hangings</i></li> </ul>	<ul style="list-style-type: none"> <li>○ Discuss with the pupils:           <ul style="list-style-type: none"> <li>– how companies market their products</li> <li>– how they decide what to buy</li> <li>– when they decide what they want to buy</li> <li>– what point-of-sale advertising has influenced them</li> <li>– what the Advertising Standards Authority is and why it is needed</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>○ describe possible locations for point-of-sale marketing in a given situation, giving advantages and disadvantages</li> </ul>	
<ul style="list-style-type: none"> <li>○ to identify the important features of graphic communication for marketing</li> </ul>	<ul style="list-style-type: none"> <li>○ Show the pupils a video or mount a photographic display of different approaches to window dressing. Discuss the approaches with the pupils.</li> <li>○ Discuss with the pupils examples of moving displays and advertising (show them pictures/photographs of some examples).</li> </ul>	<ul style="list-style-type: none"> <li>○ identify and describe the significant graphical features used in marketing, <i>eg logos, fonts, colour</i></li> <li>○ identify a range of approaches to window dressing and relate these to their personal preferences as consumers</li> </ul>	<ul style="list-style-type: none"> <li>• Show pupils a video on window dressing and ask them to make notes on the main approaches or other key points. Ask pupils to discuss, in groups of four or five, what attracts them in window displays of different products.</li> </ul>

■ essential activities

○ optional activities

**Learning objectives**

Pupils should learn:

- to consider the constraints placed on designs that arise from the marketing context, eg *cost, short product life*

**Possible teaching activities**

- Discuss with the pupils the concept of visual communication, eg *What makes people stop and stare?* Ask the pupils to collect examples of approaches to advertising for a range of products, eg *Benetton, Swatch, Persil, Andrex, Sega*. Look at and discuss the examples in groups or as a class.

**Learning outcomes**

Pupils:

- explain why particular materials, shapes and sizes have been used in the advertising of a product for functional, aesthetic and cost reasons

**Points to note****FOCUSED PRACTICAL TASKS (FPTs)**

These practical tasks should focus on the knowledge, skills and understanding outlined in 'About the unit'. They should give pupils an opportunity to practise any new skills they will need during the DMA.

- that there are four kinds of motion and that mechanisms can be used to change one kind of motion into another
- how to design mechanisms using cams and linkages to create a particular kind of motion

- Ask the pupils to explore and analyse the working of cam and linkage mechanisms. Tasks could include discovering how the mechanisms convert the four main types of movement: linear, reciprocating, rotary and oscillating.  
Extension: some pupils could also adapt and combine mechanisms to achieve particular motions, eg *they could use a modelling kit to build their own models to given designs, or provide prebuilt models.*

- describe how the components of a mechanism create or change motion, eg *identify an eccentric cam and recognise that it turns rotary motion into reciprocating motion*
- design mechanisms for a stated purpose, eg *to make a puppet's head rise a fixed amount when a handle is turned*

- to design and construct simple electrical control circuits that include switches and outputs in parallel and series, protection of LEDs and reversing control of motors
- that output devices, including motors, can be controlled using switches

- Set up activities in which the pupils explore and learn about electrical control and create and investigate simple switching and output control circuits including effective motor control, eg *tasks based on electrical modelling boards or bare components in a breadboard, supplemented by the use of computer-based electrical-modelling software, if this is available.*

- design, model and construct simple control circuits
- design and construct circuits that include effective motor control, eg *simple reversing circuits*

**Language for learning when using technical vocabulary**

- Pupils should use a range of vocabulary accurately in their notes, planning and recording/reflecting.
- Teachers need to ensure that spellings are learnt accurately to avoid error reinforcement. Common errors might include:
  - single/double letters, eg *oscillate*, *parallel*, *emitting*
  - unstressed sounds, eg *resistor*, *rotary*, *axle*

■ essential activities

○ optional activities

**Learning objectives**

Pupils should learn:

- to design and carry out fair tests to compare the strength of frame and sheet structures
- to design structures that are strong, using their qualitative knowledge of structural strength

- that levers can be used to change the amount and the force of a movement
- how to include levers in their mechanical designs to achieve a change in movement

- to solder components and wires together effectively and safely

- about methods of creating lettering and their relative merits in different situations

- to select appropriate lettering styles for a particular type of communication

**Possible teaching activities**

- Organise activities that allow the pupils to learn about structures and how to build robust and stable frame and sheet structures, *eg they could design and conduct tests to determine the strongest frame and sheet designs*. Provide a range of initial designs, so that the pupils gain experience of effective and ineffective designs.  
Extension: some pupils might also create and test their own designs.

- Set up activities in which the pupils explore and analyse how levers can be used to change the amount of movement and to increase the force of movement, *eg through work with a levers kit*.

- Set up an activity in which pupils learn how to solder, *eg to construct a simple switching circuit through soldering*.

- Show the pupils different ways of creating lettering. Give them an opportunity to try a range of different approaches, *eg hand drawing, templates/stencils, rub-down lettering, ICT combined with a printer and, if available, a vinyl cutter*.

- Show the pupils how to match the type of lettering (font) with the purpose of the communication, *eg*
  - *collecting examples and looking at the way fonts are used in advertisements, magazines and posters*
  - *creating a poster that uses fonts effectively to carry its message*

**Learning outcomes**

Pupils:

- select and set up appropriate, fair comparative tests to establish the strength of different frame and sheet structure designs
- design, model and construct simple structures for a purpose


- describe qualitatively how levers change the amount and force of a movement
- understand and use correctly terms of qualification and comparison, *eg more, less, -er, -est, increased, decreased*, to create an accurate description
- design mechanisms that include levers to achieve a particular outcome


- use a soldering iron to produce effective electrical contacts between wires and components, following safety procedures

- select and use appropriate ways of creating lettering to improve the appearance of their product

- select and use lettering styles that are appropriate for the purpose of the communication, *eg a decorative font to emphasise the theme of a poster, an easily readable font in a poster for young children*

**Points to note**

 **Health and safety** – pupils should be taught about hazards, risks and risk control when carrying out structural testing activities, to ensure that the collapse of structures does not endanger themselves or damage the workshop, *eg falling weights should be caught in a sand tray, pupils' eyes may need protection*

 **Health and safety** – correct health and safety procedures should be followed when soldering. Solder with rosin-free flux should be used, and the room should be well ventilated. Each soldering station should have sufficient space, low-voltage irons or irons with burn-resistant flexes should be used, and hands should be washed after soldering

**Use of ICT**

- Pupils could use a printer and/or a plotter/cutter to produce lettering.

■ essential activities

○ optional activities