Unit 6C Fairground
Focus – control: electrical

ABOUT THE UNIT

This unit enables children to gain understanding of an important mechanism, using belts and pulleys, and to learn more about control using electricity and an electric motor. Children can then be introduced to computer control. The focus of the unit is to design and make a model of a fairground ride but it could be adapted to suit any product in which an electric motor produces rotating movement.

Unit 6D 'Controllable vehicles' is an appropriate alternative to this unit.

PRIOR LEARNING

It is helpful if the children have:

- learnt about electrical circuits and a variety of electrical components
- made models with rotating parts *eg wheeled vehicles* and a variety of models made with construction kits

This unit builds on Units 2A 'Vehicles', 3C 'Moving monsters', 4C 'Torches', 4D 'Alarms' and 5C 'Moving toys'.

It also builds on Science Units 2F 'Using electricity', 4F 'Circuits and conductors', 6G 'Changing circuits' (short unit) and on IT Unit 5E 'Controlling devices'.

VOCABULARY

In this unit, children will use words and phrases relating to:

- designing *eg model, mock-up, select, modify, improvements, design proposal, criteria*
- making *eg framework, construct, temporary joins, permanent joins*
- knowledge and understanding *eg rotation, spindle, axle, drive belt, pulley, electric motor, speed, framework, horizontal, vertical, electric circuit, switch, gearing up or down, computer control, mechanism*

RESOURCES

- batteries, motors with small pulleys to fit, elastic bands (up to 20 cm), switches, crocodile connecting leads, aluminium foil
- construction kit components including pulleys, pulley wheels
- cotton reels
- wood scraps which might be used as a base
- construction material suitable for making a framework *ie wood strips and card corners OR card boxes*
- doweling or stiff wire for making spindles or axles
- variety of materials for making the rides *eg card, reclaimed materials*
- assorted paper, ribbon, string, elastic bands, paper plates, adhesive, sticky tape, saws, drills and bits
- tools for cutting and shaping the above materials
- computer and interface connection

EXPECTATIONS

at the end of this unit

most children will:	have become familiar with how an electric motor behaves when connected in an electrical circuit; have generated several ideas to choose from; have harnessed the rotation produced by the motor to drive a moving part on a model they have made, employing belts and pulleys; have designed, made, evaluated and modified their ride and linked it to computer control
some children will not have made so much progress and will:	have relied more on a construction kit to produce a model with a rotating part, which may or may not be driven by an electric motor and may not have used computer control
some children will have progressed further and will:	have analysed possible designs to some depth against the design criteria, displaying an awareness of constraints and the implications of changes; have produced a working model which can rotate at different speeds and may include other rotating mechanisms within the model; have produced a model whose appearance and finish is of a high standard; have communicated their design ideas clearly and implemented improvements

LEARNING OBJECTIVES CHILDREN SHOULD LEARN	POSSIBLE TEACHING ACTIVITIES	LEARNING OUTCOMES CHILDREN
INVESTIGATIVE, DISASSEMBLY AND EVALUATIVE ACTIVITIES (IDEAs)		
• that there are a variety of products which incorporate a pulley and a drive belt and are driven by a motor or a computer • how control systems are used in everyday life • the appropriate vocabulary related to control systems	■ Visit a fairground, or use a video or photographs of rides that have rotating parts. Discuss the children's experience of such rides. – *How does the ride turn?* – *Can you see the mechanism which turns the ride?* – *What are the different parts called?* – *How are the components joined together?* □ The children could examine a collection of toys and other appliances in which there are electric motors *eg toy vehicles, battery-operated fan, battery-operated shaver, cassette player.* □ With the children, look at mechanisms in which a belt and pulley is used *eg car fan belt, electric sewing machine, record player turntable, vacuum cleaner, roller blind.* **Safety: Ensure that these appliances are not plugged in or running when being examined.**	• identify products which incorporate a pulley and drive belt and are driven by a motor or are computer controlled • identify control systems in everyday life and name the key elements of a system
FOCUSED PRACTICAL TASKS (FPTs)		
• that they can model their ideas for their own product using mechanisms, by using construction kits or making a model from a set of instructions • how to include an electric motor in a simple circuit • how the direction of rotation and speed of an electric motor can be controlled • how rotation can be transferred from one part of a model to another by using pulleys and a belt • how a belt and pulley system can reverse the direction of rotation (by twisting the belt through 180 degrees) • how a belt and pulley system can turn the plane of rotation through 90 degrees (by twisting the belt through 90 degrees) • how a belt and pulley system can increase or decrease the speed of rotation (by using different size pulleys)	■ Ask the children to investigate different ways of making a framework to hold the model *eg build the model on a baseboard, use card and straws, use a framework with added triangles or diagonals, use a construction kit.* Consider carefully how to support the rotating part on a well-supported axle or a spindle. ■ Show the children how a model can be controlled with a computer. Motor speed and direction can be controlled and a sequence of operations can be developed by the children writing a simple program of instructions. □ The children could use elastic bands and pulley *eg cotton reels on spindles* to investigate transferring movement from one axle to another. □ The children could use construction kit components to investigate and to change the speed of rotation, using belts and pulleys. □ The children could use a pulley on an electric motor with an elastic band to produce rotation of cotton reels on a spindle or a drinks can on an axle. Hold the electric motor in different positions to discover the best arrangement.	• connect an electric motor in a circuit to make it work in various ways • use a belt and pulley system to produce a variety of types of rotation *eg reverse, in another plane, faster, slower* • use construction kit components to model their ideas for parts of a product they would like to make
DESIGN AND MAKE ASSIGNMENT (DMA)		
Design and make a model of a fairground ride • to make decisions with regard to the type of ride they will make • to model their intended fairground ride • to make modifications as they go along • to evaluate against their original criteria and suggest ways that their ride could be improved	★ Discuss which type of ride the children will make *eg roundabout type (horizontal rotation) or Ferris wheel type (vertical rotation).* Restrict the children's choices to one of these for simplicity and manageability; explain to the children the aspects of the design that are set (*eg according to materials available)* and those aspects about which they have free choice *(eg colour, finish, style).* Ask the children to list their design criteria in order of importance. *'To be successful our fairground ride should.....'* ★ Discuss how they will finish their model. ★ Ask the children to make a model of the mechanism they will use by employing a construction kit or simple card box to hold the components. (They should be able to play around with and alter this preliminary model quickly and easily at this stage. This 'mock-up' could be taken as equivalent to a design drawing for this project). ★ Ask the children to make the rotating part of their product first and ensure that it can be rotated freely by hand. ★ Then the children can add the electric motor and drive belt. ★ After this the children can finish their ride *eg by adding cladding, colour, seats.* ★ Ask the children to evaluate their product by referring to their own criteria for success. – *Does the model rotate freely without the motor?* – *Does the motor drive the ride at the right speed?* – *Is the product an interesting fairground ride?* – *Does the product have a strong and stable framework?* ★ Children's models can be connected to the computer via an interface. Using appropriate software, features *eg flashing bulbs and buzzers* can be controlled.	• apply what they have learnt through IDEAs/FPTs in their designing and making • decide which type of ride they will make • model their design using temporary fixings • identify criteria for their ride against which it will be evaluated both during and at the end of the making stage • make a product in which an electric motor successfully drives a rotating part • control a model using an interface connection to a computer • evaluate the effectiveness of their design and are able to adjust it to improve efficiency or effectiveness

■ essential activities
★ assignment stages (all are essential)
□ optional activities

POINTS TO NOTE

Links to this unit
Science: Unit 6G 'Changing circuits' (short unit)

Information technology: Units 5E 'Controlling devices', 6C 'Control and monitoring – What happens when....?'

Mathematics: Revolve, revolution, degree

Content
- It is important to provide a purpose for this assignment *eg a promotional model that is in a shop two weeks before the fair comes to town.*
- This unit will provide a challenge for children who have already gained experience in constructing models with moving parts and with using electrical circuits.
- The focus is on getting the various mechanisms to work successfully rather than on producing a sophisticated and realistic model of a fairground ride.
- There are a number of features of construction to which special attention will have to be paid:
  – the rotating part of the product must turn on a spindle or axle which is supported by a strong and stable framework
  – a 'pulley' can be commercially produced, made by the children or can be the axle itself
  – the drive belt (which can be an elastic band) must be at the right tension between the two 'pulleys', so position the motor carefully
  – it is best to have a small 'pulley' on the motor and as large a one as possible on the turning part in order to gear down the turning speed.

Class management
- Many of the IDEAs and FPTs could be carried out in science sessions.
- Children could work in pairs or small groups (four children) to produce the ride. They would need to produce a clear plan, detailing who does which task before they progress to the making stage.
- Teachers will want to ensure that they are confident with solving the technical problems associated with this kind of project. It is all too apparent in such a task when things are not working.
- Children can be taught to discover and rectify the faults in an electrical circuit without help from the teacher.
- They can overcome the problems involved in making parts rotate if they have had plenty of experience, either in previous tasks or during the FPTs in this project.

Health and safety
When carrying out a risk assessment for this activity, teachers will need to consider the materials, tools and equipment being used.

In addition, the following points should be noted:
- explain to children that they should not experiment with mains electricity and should only use batteries in commercially available appliances unless supervised by an adult
- it is inadvisable to use rechargeable batteries for home-made circuits - in the event of a short circuit they could get very hot and cause injury
- children should not investigate the rotating parts of mechanisms in machines without adult supervision and only when there is no chance of a sudden rotation

Out-of-school activities and homework
Children could visit a fairground or a museum to see rides in action. They could be encouraged to use any toys or construction kits at home to experiment with pulleys and drive belts and/or electric motors.

They could draw annotated drawings of what they make, including exploded diagrams of how specific parts are put together and how they move.

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