

ACET Junior Academies

Scheme of Work for Design Technology
Y5 Mechanical Systems - Pulleys or Gears



About this unit: In this unit pupils will learn about products that incorporate gear or pulley systems. They will investigate a range of toys and other products and will learn how the mechanisms work, further developing their understanding of input, process and output. Children will explore making gear and pulley systems using construction kits and learn how to control the system manually and with an electrical circuit. Pupils will design a moving product for an intended user and purpose. They will apply their learning from the unit to make their product and will evaluate their completed products, judging the extent to which they have met the original design criteria.

Final piece ideas: Fairgrounds - Merry-go-rounds/carousels, (link Victorians)

Unit structure

1. Investigate and Evaluate: What are pulleys and gears and how do they work?
2. Focused Tasks: How can you make pulley or gear mechanism?
(May require two lessons)
3. Designing: What could I make and how will I make it?
4. Making - Planning and making: Can I make the product I designed?
5. Making - Finishing: How will I make my product appealing?
6. Evaluating: What went well? How could I improve my product?

Links to previous and future National Curriculum units

- KS1 - Sliders and levers
- LKS2 - Levers and Linkages
- LKS2 - Electrical Systems
- UKS2 - Frame structures

1: Investigate and Evaluate – What are pulleys and gears and how do they work?

Links to previous learning	Knowledge and second order concepts	Skills, Concepts and Vocabulary:	Assessment criteria:	Curricular links:
<p>Pupils will have experience of axles, axle holders and wheels that are free, fixed or moving.</p> <p>They will have a basic understanding of electrical circuits, simple switches and components.</p> <p>Pupils will have experience of cutting and joining techniques with a range of materials including card, plastic and wood.</p> <p>Pupils will have an understanding of how to strengthen and stiffen structures.</p>	<p>Substantive knowledge: (<i>What students should know.</i>)</p> <p>That there are a range of products that use pulley or gear mechanisms.</p> <p>That products have been designed, produced and evaluated.</p> <p>Understand how a key event/individual has influenced the development of the chosen product and/or fabric.</p> <p>That products can be evaluated on design, manufacture, appearance and use.</p> <p>Second order concepts: (<i>What students should understand</i>)</p> <p>Evaluation</p> <p>Purpose</p> <p>Function</p> <p>Innovation</p>	<p>Skills</p> <ul style="list-style-type: none"> • Evaluate and discuss existing products, considering how well they have been made, the materials chosen, whether they work, how they have been made and if they are fit for purpose. • Identify what the product has been made from and research how sustainable the materials are. • Begin to evaluate how much products cost to make and how innovative they are. • <p>Key vocabulary/concepts:</p> <p>Evaluate, user, purpose, product, function, functionality, innovation design decisions, mechanism, mechanical component, input, process, output, pulley, drive belt, gear, rotation, spindle, driver, follower, axle, motor</p>	<p>Can your children:</p> <p>Explore a range of every day products and toys which have pulleys and gears.</p> <p>Understand what products are and what their purpose is.</p> <p>Evaluate products on design, manufacture, appearance and use.</p>	<p>Horizontal:</p> <p>Spoken language - as questions, formulate, articulate and justify answers, arguments and opinions; consider and evaluate different viewpoints.</p> <p>History - Victorians - Merry-go-rounds/toys</p> <p>Vertical:</p>

Suggested activities:	Resources:	Useful links:
<p>Provide pupils with a range of everyday products and existing or pre-made toys that incorporate gear or pulley systems to investigate, analyse and evaluate. Use videos/images of products that cannot be explored through first-hand experience. Pupils could research pulleys and gears in everyday life. Use questions and research to develop the children's understanding of the products and to introduce and develop technical vocabulary. <i>e.g. How innovative is the product? What design decisions have been made? What type of movement can be seen? What types of mechanical components are used and where are they positioned? What are the input, process and output of the system? How well does the product work? Why have the materials and components been chosen? How sustainable are the materials? How well has it been designed? How well has it been made?</i></p> <p>Pupils complete an evaluation of a chosen product(s), using appropriate language to explain how a product works.</p>	<p>Range of everyday products and toys with pulleys or gears. Images and film clips of products that cannot be explored physically.</p>	<p>https://sciencing.com/examples-pulleys-everyday-life-7231681.html</p> <p>https://www.schoolsofkingedwardvi.co.uk/ks2-science-year-5-5c-forces-simple-machines/</p> <p>https://www.stem.org.uk/resources/community/collection/13378/gears-levers-and-pulleys</p> <p>http://www.mrjennings.co.uk/teacher/DT/D&T%20Upper%20KS2%20project%20sheets.pdf</p>

2: Focused Tasks (1)

Links to previous learning	Knowledge and second order concepts	Skills, Concepts and Vocabulary:	Assessment criteria:	Curricular links:
<p>Pupils will have explored and analysed a range of products with pulleys and gears, identifying what they are and what their purpose is. They will have evaluated products on design, manufacture, appearance and use.</p>	<p>Substantive knowledge: (What students should know.) Understand that mechanical systems have an input, process and an output. Understand how gears and pulleys can be used to speed up, slow down or change the direction of movement. Know and use technical vocabulary relevant to the project.</p> <p>Second order concepts: (What students should understand)</p>	<p>Skills</p> <ul style="list-style-type: none"> • Know how to use learning from Science and maths to help design and make products that work • Identify the functional properties and aesthetic qualities of materials and discuss how these make them suitable for the product. • that mechanical and electrical systems have an input, process and output • how mechanical systems such as cams or pulleys or gears create movement 	<p>Can your children: Understand and explain how mechanical and electrical systems work. Use construction kits and electrical components to construct mechanical and electrical systems. Understand how gears and pulleys can be used to change speed and movement.</p>	<p>Horizontal: Maths - use and understand ratios; carry out accurate measuring (cm/mm) Spoken language - ask relevant questions to extend knowledge and understanding. Science - apply knowledge and understanding of circuits</p> <p>Vertical:</p>

		<ul style="list-style-type: none"> • Assemble, join and combine materials and components with increasing accuracy. • • how more complex electrical circuits and components can be used to create functional products • Follow procedures for safety • Accurately measure, mark out, cut and shape materials and components • Accurately assemble, join and combine materials and components <p>Key vocabulary/concepts: Pulley, gear, drive belt, spindle, driver, follower, ratio, motor, circuit, switch, mechanical system, electrical system, input, process, output</p>		
Suggested activities:		Resources:	Useful links:	
<p>(This could be covered over two lessons)</p> <p>Pupils use construction kits to build mechanical systems to develop understanding of input, process and output. Pupils could investigate combinations of two different sized pulleys to learn about direction and speed of rotation. Ask questions to develop understanding e.g. <i>Which is the driver? Which is the follower? What is the input/output? How many times does the smaller pulley turn each time the larger pulley turns once? Do the pulleys move in the same direction? How can you reverse the direction of rotation?</i></p> <p>Pupils could use construction kits to explore combinations of two different sized gears meshed together. Investigate the direction and speed of rotation focusing on how the size of the driver affects the speed of the follower gear. Pupils could use the number of teeth on each gear to begin to develop an idea of ratios e.g. a 10 tooth driver meshed with a 20 tooth follower produces a ratio of 2:1.</p>		<p>Batteries, battery holders, wires, crocodile clips, motors, switches, construction kits including pulleys and gears of different sizes and elastic bands.</p>	<p>https://www.bbc.co.uk/bitesize/guides/zhq8jty/revision/1</p> <p>http://www.mrjennings.co.uk/teacher/DT/D&T%20Upper%20KS2%20project%20sheets.pdf</p>	

<p>Challenge pupils to build mechanical systems using pulleys or gears to achieve a given outcome.</p> <p>Pupils could create electrical systems by building working circuits that incorporate a battery, a motor and a handmade switch, such as a reversing switch.</p> <p>Pupils could draw a pictorial representation of the circuit or draw a circuit diagram using correct symbols. Pupils investigate using motors and pulleys of different sizes. Challenge pupils to create an electrical system to achieve a given outcome. Pupils evaluate both mechanical and electrical systems, considering their advantages and disadvantages.</p>		
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3: Designing

Links to previous learning	Knowledge and second order concepts	Skills, Concepts and Vocabulary:	Assessment criteria:	Curricular links:
<p>Children will have an understanding of mechanical and electrical systems. They will know how to mark, cut and join materials to make frames for their systems.</p>	<p>Knowledge: Substantive knowledge: <i>(What students should know.)</i> That a design brief outlines what a user wants a product to be like. That research should be carried out to inform design ideas. That responses from research should be used to inform the design specification.</p> <p>Second order concepts: <i>(What students should understand)</i> Design brief Design criteria Design specification</p>	<p>Skills</p> <ul style="list-style-type: none"> • Describe the purpose of their product and the features that will appeal to the user • Gather information about the needs, wants, preferences and values of particular individuals and groups, carrying out surveys, questionnaires etc. • Develop a simple design specification to guide their thinking • Share and clarify ideas through discussion • Communicate and represent ideas in exploded diagrams, 	<p>Can your children: Develop ideas about the product they are going to make based on the needs, wants, preference and values of the user. Communicate ideas through annotated sketches and exploded drawings.</p>	<p>Horizontal: Science - apply knowledge and understanding of circuits and switches in the design of the final product. Select materials based on their properties. Art and design - use drawings and sketches to develop and communicate ideas. Spoken language - participate in</p>

		<p>annotated sketches and cross sectional drawing</p> <ul style="list-style-type: none"> • Draw on research to generate innovative ideas • Produce a list of tools, equipment and materials they need • Record a step-by-step plan for making <p>Key vocabulary/concepts: Design decisions, functionality, innovation, authentic, user, purpose, design specification, design brief, annotated drawings, exploded diagrams</p>		<p>discussion to generate, develop and communicate ideas.</p> <p>Vertical:</p>
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Suggested activities:	Resources:	Useful links:
<p>Develop a design brief with pupils within a context which is authentic and meaningful for a product e.g. a moving toy</p> <p>Children carry out research including surveys, interviews and questionnaires and develop innovative ideas through discussion.</p> <p>Develop a design specification for their product, carefully considering the purpose and intended user for their product.</p> <p>Pupils could use annotated sketches and/or exploded diagrams to communicate their ideas. Pupils could also consider availability of resources, cost, sustainability of materials.</p> <p>Pupils produce a design proposal detailing the tools, equipment and materials they will use and a step by step plan of how it will be made.</p>		<p>http://www.primaryhomeworkhelp.co.uk/victorians/toys.htm</p> <p>http://www.mrjennings.co.uk/teacher/DT/D&T%20Upper%20KS2%20project%20sheets.pdf</p>

4: Making

Links to previous learning	Knowledge and second order concepts	Skills, Concepts and Vocabulary:	Assessment criteria:	Curricular links:
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<p>Pupils will have carried out research and developed ideas based on the needs, wants, preferences and values of an intended user. They will have communicated ideas through drawings and diagrams. Pupils will have considered the stages of making and will have produced a step-by-step plan.</p>	<p>Knowledge: Substantive knowledge: <i>(What students should know.)</i> That design proposals and criteria are used to guide the making process. The importance of working within the constraints of time and cost The importance of evaluating ongoing work.</p> <p>Second order concepts: <i>(What students should understand)</i> Functionality Constraints of time/cost Evaluate</p>	<p>Skills</p> <ul style="list-style-type: none"> • Use a wider range of materials and components • Work safely, hygienically and accurately with a wider range of tools. • Accurately measure, mark out, cut and shape materials and components. • Assemble, join and combine materials and components with increasing accuracy. • Begin to demonstrate resourcefulness when tackling practical problems. <p>• Key vocabulary/concepts: Intended user, purpose, design criteria, design specification, design brief, pulley, gear, drive belt, spindle, driver, follower, ratio, motor, circuit, switch, mechanical system, electrical system, input, process, output</p>	<p>Can your children: Accurately measure, mark out and cut out materials? Accurately assemble, join and combine materials to create products? Consider the purpose and the needs of the intended user? Evaluate evolving work and use problem solving skills when encountering mistakes or problems?</p>	<p>Horizontal: Select and use materials based on their properties. Apply knowledge and understanding of circuits in the make of the product.</p> <p>Vertical:</p>
<p>Suggested activities:</p>	<p>Resources:</p>	<p>Useful links:</p>		
<p>Give pupils the opportunity to revisit their design specifications and step-by-step plans. Pupils collect the materials and tools required for their product and apply the knowledge, skills and techniques learned from previous lessons when making their products. Encourage the children to evaluate their developing products by referring to the design criteria, considering the intended purpose and user. Encourage pupils to identify why things have gone wrong and use their knowledge and skills to solve problems. Pupils record changes made to overcome problems or any improvements made on their plans.</p>	<p>Range of card, masking tape, paper fasteners, glue stick, PVA glue, scissors</p>	<p>http://www.mrjennings.co.uk/teacher/DT/D&T%20Upper%20KS2%20project%20sheets.pdf</p>		
<p>5: Finishing</p>				

Links to previous learning	Knowledge and second order concepts	Skills, Concepts and Vocabulary:	Assessment criteria:	Curricular links:
<p>Pupils will have constructed an electrical or mechanical system using pulleys or gears to create movement.</p> <p>Pupils will have constructed the product, building in the pulleys or gears.</p> <p>Pupils will have used problem solving skills to overcome mistakes or problems.</p>	<p>Substantive knowledge: (<i>What students should know.</i>)</p> <p>That products need to be finished to a high quality to make them appealing to the intended user.</p> <p>Know a range of techniques suitable for the product they are creating.</p> <p>The importance of evaluating evolving work.</p> <p>Second order concepts: (<i>What students should understand</i>)</p> <p>Finish</p> <p>Appeal</p> <p>Innovative</p>	<p>Skills</p> <ul style="list-style-type: none"> Apply a range of finishing techniques, including those learnt in Art with increasing accuracy Begin to demonstrate resourcefulness when tackling practical problems. <p>Key vocabulary/concepts:</p> <p>Design brief, design criteria, design decisions, finish/finishing techniques, appearance, appealing, innovative,</p>	<p>Can your children:</p> <p>Accurately apply a range of finishing techniques suitable for the product they are making, including those learned in Art?</p> <p>Evaluate their developing products and use problem solving skills when things go wrong?</p>	<p>Horizontal:</p> <p>Art and design - use a range of finishing techniques</p> <p>Vertical:</p>

Suggested activities:

Refer to design specification and proposal. Pupils evaluate initial ideas, identify any changes to the finish, explaining their reasons.

Pupils select appropriate materials and decorating finishing techniques to produce a well finished final product that matches the intended user and purpose. Pupils evaluate their ongoing work, using problem solving skills when they encounter mistakes or problems. Pupils record any changes made to overcome problems or to improve their product on their plan.

Resources:

Finishing resources, e.g. pens, pencils, paint, glue,

Useful links:

<http://www.mrjennings.co.uk/teacher/DT/D&T%20Upper%20KS2%20project%20sheets.pdf>

6: Evaluating

Links to previous learning	Knowledge and second order concepts	Skills, Concepts and Vocabulary:	Assessment criteria:	Curricular links:
<p>Children will have generated and developed ideas for their product. They will have explored different mechanical and electrical systems</p>	<p>Substantive knowledge: (<i>What students should know.</i>)</p> <p>That evaluations identify the strengths and areas for development in terms of quality of design, manufacture and whether it is fit for purpose.</p> <p>That products are continually developing through evaluating and identifying improvements.</p>	<p>Skills</p> <ul style="list-style-type: none"> Use their design criteria to critically evaluate their product in terms of quality of design, manufacture and whether it is fit for its intended purpose. 	<p>Can your children:</p> <p>Use their design criteria to critically evaluate their product in terms of quality of design, manufacture and</p>	<p>Horizontal:</p> <p>Spoken language - as questions, formulate, articulate and justify answers, arguments and opinions;</p>

<p>and designed a product with an intended purpose for an intended user. They will have chosen techniques to make and finish their product. They will have evaluated their evolving work and overcome problems using problem solving skills.</p>	<p>That views from the user should be considered when identifying areas for improvement</p> <p>Second order concepts: (What students should understand)</p> <p>Evaluate Develop Evolve Innovative</p>	<ul style="list-style-type: none"> Consider the views of others, including intended users, to improve their work. <p>Key vocabulary/concepts: Evaluate, design criteria, design brief, innovative, user, purpose, authentic, innovative, function, product, ideas, appeal, finish, improve</p>	<p>whether it is fit for the intended purpose? Consider the views of others when evaluating their work and identifying improvements that could be made.</p>	<p>consider and evaluate different viewpoints.</p> <p>Vertical:</p>
<p>Suggested activities:</p>		<p>Resources:</p>	<p>Useful links:</p>	
<p>Pupils evaluate their final products, comparing it to the original design specification. They should critically evaluate the quality of design, the manufacture, functionality, innovation and fitness for the intended user and for purpose. against the design criteria. They consider the extent to which the product meets the needs of the intended user and suits the intended purpose.</p> <p><i>Does the product suit the purpose? Does it suit the intended user? Does the mechanism work smoothly? Is it the right kind of movement? How well has the product been made? Are the materials suitable for the product? How could the product be made more appealing?</i></p> <p>Where possible allow feedback from the intended user.</p> <p>Pupils complete an evaluation for their own product.</p>		<p>Final products Evaluation resources</p>	<p>http://www.mrjennings.co.uk/teacher/DT/D&T%20Upper%20KS2%20project%20sheets.pdf</p>	