

Learning journey	Design Technology	Mechanisms – vehicles	Year 6 – Autumn	
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Building on prior learning	Theme overview	Preparing for future learning	Vocabulary	
<p>In Yr4, children will learn to:</p> <p>Design:</p> <ul style="list-style-type: none"> •Generate realistic ideas and their own design criteria through discussion, focusing on the needs of the user. • Use annotated sketches and prototypes to develop, model and communicate ideas. <p>Making:</p> <ul style="list-style-type: none"> • Order the main stages of making. • Select from and use appropriate tools with some accuracy to cut, shape and join paper and card. • Select from and use finishing techniques suitable for the product they are creating. <p>Evaluating:</p> <ul style="list-style-type: none"> • Investigate and analyse books and, where available, other products with lever and linkage mechanisms. • Evaluate their own products and ideas against criteria and user needs, as they design and make. <p>Technical skills:</p> <ul style="list-style-type: none"> • Understand and use lever and linkage mechanisms. • Distinguish between fixed and loose pivots. • Know and use technical vocabulary relevant to the project. 	<p>The pupils will know: How different components are arranged in order to make a model move.</p> <p>The pupils will study: How to use working, moving parts in to models in order to create a moving vehicle.</p> <p>They will learn: How pulleys and gears are used to create working parts in vehicles and mechanical components.</p> <p>They will investigate: The function of pulleys and gears and how these are used to create movement.</p>	<p>In KS3, children will learn to:</p> <p>Design: use research and exploration, such as the study of different cultures, to identify and understand user needs</p> <ul style="list-style-type: none"> · identify and solve their own design problems and understand how to reformulate problems given to them · develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations · use a variety of approaches [for example, biomimicry and user-centred design], to generate creative ideas and avoid stereotypical responses · develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations and computer-based tools <p>Making: select from and use specialist tools, techniques, processes, equipment and machinery precisely, including computer-aided manufacture</p> <ul style="list-style-type: none"> · select from and use a wider, more complex range of materials, components and ingredients, taking into account their properties <p>Evaluating: analyse the work of past and present professionals and others to develop and broaden their understanding</p> <ul style="list-style-type: none"> · investigate new and emerging technologies · test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups · understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists <p>Technical skills: understand and use the properties of materials and the performance of structural elements to achieve functioning solutions</p> <ul style="list-style-type: none"> · understand how more advanced mechanical systems used in their products enable changes in movement and force · understand how more advanced electrical and electronic systems can be powered and used in their products [for example, circuits with heat, light, sound and movement as inputs and outputs] · apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers]. 	<p>Key vocabulary that the children will be taught / use during the unit:</p> <p>pulley drive belt gear rotation spindle driver follower ratio transmit axle motor circuit switch circuit diagram annotated drawings exploded diagrams mechanical system electrical system input process output design decisions functionality innovation authentic user purpose design specification design brief</p>	<p>Safety note - ONLY USE ZINC CHLORIDE BATTERIES – other types will get hot if short-circuited</p>
NC coverage and HWJS skills development	Knowledge organisers			

National curriculum coverage for Design and Technology

Pupils should be taught to:

Key stage 1

Design

- design purposeful, functional, appealing products for themselves and other users based on design criteria
- generate, develop, model and communicate their ideas through talking, drawing, templates, mock-ups and, where appropriate, information and communication technology

Make

- select from and use a range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing]
- select from and use a wide range of materials and components, including construction materials, textiles and ingredients, according to their characteristics

Evaluate

- explore and evaluate a range of existing products
- evaluate their ideas and products against design criteria

Technical knowledge

- build structures, exploring how they can be made stronger, stiffer and more stable
- explore and use mechanisms [for example, levers, sliders, wheels and axles], in their products.

Key stage 2

Design

- use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups

- generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design

Make

- select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately
- select from and use a wider range of materials and components, including construction materials, textiles and ingredients, according to their functional properties and aesthetic qualities

Evaluate

- investigate and analyse a range of existing products
- evaluate their ideas and products against their own design criteria and consider the views of others to improve their work

- understand how key events and individuals in design and technology have helped shape the world

Technical knowledge

- apply their understanding of how to strengthen, stiffen and reinforce more complex structures
- understand and use mechanical systems in their products [for example, gears, pulleys, cams, levers and linkages]
- understand and use electrical systems in their products [for example, series circuits incorporating switches, bulbs, buzzers and motors]
- apply their understanding of computing to program, monitor and control their products.

Details of the national curriculum links that relate to the unit being taught

HWJS skills development

Design:

- Generate innovative ideas by carrying out research using surveys, interviews, questionnaires and web-based resources.
- Develop a simple design specification to guide their thinking.
- Develop and communicate ideas through discussion, annotated drawings, exploded drawings and drawings from different views.

Making:

This contains the key knowledge that the children will be taught during the unit of work – this should match up with the knowledge organiser overview

1. Year Groups
Years 5/6

2. Aspect of D&T
Mechanical systems
Focus
Pulleys or Gears

4. What could children design, make and evaluate?
fairground ride with gears or pulleys e.g. carousel, Ferris wheel
controllable toy vehicle with gears or pulleys e.g. dragster, off-road vehicle, sports car, lorry, window display with moving parts e.g. lifting or turning items for sale other – specify

5. Intended users
peers siblings younger children
older children specific individuals
target groups company other – specify

6. Purpose of products
entertainment pleasure play
educational interests and hobbies
business other – specify

16. Possible resources
videos, photographs and everyday products or toys with pulleys or gears
batteries, battery holders, wires, crocodile clips, motors, switches, aluminium foil, paper fasteners, paper clips, card, motors, motor stands, dowel, paper sticks
consumable and construction kit pulleys or gears of different sizes, elastic bands
junior hacksaws, glass paper, G-clamps, bench hooks, hand drill, automatic wire strippers
PVA glue, sticky pads, masking tape, dowel, double-sided tape, card triangles, square section wood, card, corrugated plastic, finishing media

17. Key vocabulary
pulley, drive belt, gear, rotation, spindle, driver, follower, ratio, transmit, axle, motor
circuit, switch, circuit diagram
annotated drawings, exploded diagrams
mechanical system, electrical system, input, process, output
design decisions, functionality, innovation, authentic, user, purpose, design specification, design brief

3. Key learning in design and technology
Prior learning
• Experience of axles, axle holders and wheels that are fixed or free moving.
• Basic understanding of electrical circuits, simple switches and components.
• Experience of cutting and joining techniques with a range of materials including card, plastic and wood.
• An understanding of how to strengthen and stiffen structures.
Designing
• Generate innovative ideas by carrying out research using surveys, interviews, questionnaires and web-based resources.
• Develop a simple design specification to guide their thinking.
• Develop and communicate ideas through discussion, annotated drawings, exploded drawings and drawings from different views.
Making
• Produce detailed lists of tools, equipment and materials. Formulate step-by-step plans and, if appropriate, allocate tasks within a team.
• Select from and use a range of tools and equipment to make products that are accurately assembled and well finished. Work within the constraints of time, resources and cost.
Evaluating
• Compare the final product to the original design specification.
• Test products with intended user and critically evaluate the quality of the design, manufacture, functionality and fitness for purpose.
• Consider the views of others to improve their work.
• Investigate famous manufacturing and engineering companies relevant to the project.
Technical knowledge and understanding
• Understand that mechanical and electrical 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.

10. Investigative and Evaluate Activities (IEAs)
• Investigate, analyse and evaluate existing everyday products and existing or pre-made toys that incorporate gear or pulley systems. Use videos and photographs of products that cannot be explored through first-hand experience.
• Use observational drawings and questions to develop understanding of each product in the collection 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 has the materials and components been chosen? How well has it been designed? How well has it been made?
• Children could research and, if possible, visit engineering and manufacturing companies that are relevant to the product they are designing and making e.g. Jaguar Land Rover, JCB, local companies

12. Focused Tasks (FTs)
• Using a construction kit, investigate combinations of two different sized pulleys to learn about direction and speed of rotation e.g. 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? AND/OR
• Using a construction kit, explore combinations of two different size gears meshed together. Investigate the direction and speed of rotation focusing on how the size of the driver gear affects the speed of the follower gear. Ask the children to use the number of teeth on each gear to decide upon the gear ratios e.g. 10 tooth driver gear meshed with a 20 tooth follower gear produces a ratio of 2:1
• Build a working circuit that incorporates a battery, a motor and a handmade switch, such as a reversing switch. Demonstrate the accurate use of tools and equipment including cutting and stripping wire, and making secure electrical connections. Remind children about the dangers of mains electricity. Draw a pictorial representation of the circuit or draw a circuit diagram using correct symbols.
• Develop measuring, marking, cutting, shaping and joining skills using junior hacksaws, G-clamps, bench hooks, square section wood, card triangles and hand drills to construct wooden frames, as appropriate. Demonstrate the accurate use of tools and equipment.

14. Design, Make and Evaluate Assignment (DMEA)
• Develop an authentic and meaningful design brief with the children.
• Children generate innovative ideas by carrying out research including surveys, interviews and questionnaires and develop a design specification for their product, carefully considering the purpose and intended user for their product.
• Communicate ideas through detailed, annotated drawings from different views and/or exploded diagrams. The drawings should indicate the design decisions made, including the location of the mechanical and electrical components, how they work as a system with an input, process and output, and the appearance and finishing techniques for the product.
• Produce detailed step-by-step plans and lists of tools, equipment and materials needed. If appropriate allocate tasks within a team.
• Make high quality products, applying knowledge, understanding and skills from IEAs and FTs. Children should use a range of decorative finishing techniques to ensure a well finished final product that matches the intended user and purpose.
• Evaluate throughout and the final product in use, comparing it to the original design specification. Critically evaluate the quality of the design, the manufacture, functionality, innovation shown and fitness for the intended user and purpose.

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.
11. Related learning in other subjects
• **Spoken language** – ask relevant questions, formulate and express opinions, give well-structured descriptions and explanations. Use relevant strategies to build their vocabulary.
• **Computing** – use search technologies for research purposes and be discerning when evaluating digital content.

13. Related learning in other subjects
• **Spoken language** – ask relevant questions, formulate and express opinions, give well-structured descriptions and explanations. Use relevant strategies to build their vocabulary.
• **Mathematics** – understand ratios. Apply understanding and skill to carry out accurate measuring using standard units i.e. cm/mm.
• **Solenoe** – apply knowledge and understanding of circuits, switches, conductors and insulators. Recognise that some mechanisms, including pulleys and gears, allow a smaller force to have a greater effect.

15. Related learning in other subjects
• **Computing** – use search technologies for research purposes and be discerning when evaluating digital content.
• **Art and design** – use and apply drawing skills. Use techniques with colour, pattern, texture, line and shape.
• **Solenoe** – apply knowledge and understanding of circuits, switches, conductors and insulators in the design of the final product.
• **Mathematics** – understand ratios. Apply understanding and skill to carry out accurate measuring using standard units i.e. cm/mm.

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.



• Produce detailed lists of tools, equipment and materials. Formulate step-by-step plans and, if appropriate, allocate tasks within a team.

• Select from and use a range of tools and equipment to make products that are accurately assembled and well finished.

• Work within the constraints of time, resources and cost.

Evaluating:

• Compare the final product to the original design specification.

• Test products with intended user and critically evaluate the quality of the design, manufacture, functionality and fitness for purpose.

• Consider the views of others to improve their work.

• Investigate famous manufacturing and engineering companies relevant to the project.

Technical skills:

• Understand that mechanical and electrical 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.

Years 5/6

**Mechanical systems
Pulleys or gears**

Instant CPD



Tips for teachers

- ✓ Sourcing existing products with gears or pulleys can sometimes be difficult. Example products using construction kits or consumable materials can be pre-made for children to investigate.
- ✓ When beginning designing and making, ensure children are focused on making the mechanical system work, rather than the decoration.
- ✓ Focused tasks should concentrate on exploring combinations gears or pulleys using construction kits. If you do not have construction kits, attach bought pulleys and gears to cardboard using paper fasteners.
- ✓ Gears require more accuracy than pulleys at the making stage but make it easier for children to understand the concept of ratio by counting the number of teeth on each gear.
- ✓ The key to success in these units is to use components that are compatible with each other e.g. components purchased should have the same diameter holes.
- ✓ When children are making, zone areas of the classroom so resources can be easily found and replaced independently.
- ✓ Investigate alternative methods of evaluating. Try making video or photographic diaries that help develop ongoing evaluation.
- ✓ Don't be afraid of incorporating any failed designs into displays of final products. Include evaluations of why 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.
- ✓ Do not use rechargeable batteries.

Useful resources from www.data.org.uk:

- Let's Get Practical Gears and Pulleys
- Let's Get Practical Developing Handmade Switches
- Faingrounds
- CPD Resources Primary Inset Guides

Other useful web-based resources:

- <http://education.staffordshire.gov.uk/Curriculum/Subjectareas/DesignandTechnology/Primary/Support/Datafile/>
- MWhet Crossover Project

D&T Association publications:

- Primary Helpsheets – Units 6C and 6D
- Primary Lesson Plans – Units 6C and 6D

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

Mechanical systems – Years 5/6 – Pulleys or gears

Developing understanding of gears and pulleys



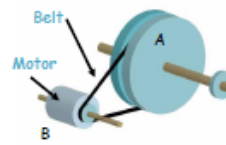
The pulleys rotate in the same direction



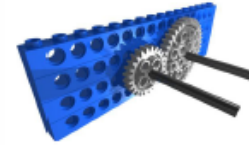
The pulleys rotate in different directions

Using construction kits, ask children to explore gear ratio using combinations of two gears e.g.

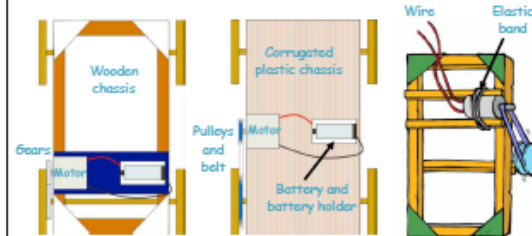
No. teeth	Ratio
8, 16	2:1
8, 40	5:1
8, 24	3:1
40, 40	1:1



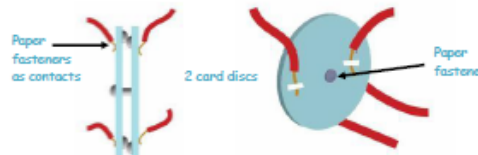
The small pulley (B) rotates much more quickly than the large pulley (A)



Building gears or pulleys into children's products



An example of a handmade reversing switch



Designing, making and evaluating a new toy vehicle for children in a particular age range

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:

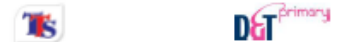
THOUGHT	ACTION
What type of toy vehicle shall I make? What will be its purpose? Who will use it?	Discussing ideas, drawing annotated sketches or exploded diagrams Generating a simple design specification
What electrical and mechanical components shall I use?	Discussing, modelling and evaluating different systems using mechanical and electrical components
Which materials will I use to make it? How will I make fit for purpose?	Investigating and trialling possible materials and components
How will I make the body shell for my toy vehicle?	Discussing, exploring and evaluating prototypes
What tools and materials will I need? What order will I work in? What constraints am I working to?	Negotiating, developing and agreeing a step-by-step-plan
Do I need to change anything?	Discussing, testing and modifying the design
Will my product meet the needs, wants and interests of the user group?	Evaluating the product with the intended user group and against the original design specification

Glossary

- Pulley** - a grooved wheel over which a drive belt can run.
- Gear** - a wheel with teeth around its circumference.
- Drive belt** - the belt which connects and transfers movement between two pulleys.
- Gearing up or down** - changing the rotational speed of a product by the use of pulleys or gears. When a small pulley or gear is used to drive a larger one the rotational speed is reduced and the product has been geared down.
- Mechanical system** - a set of related parts or components used to create movement.
- Driver** - the gear or pulley that provides the input movement to the system.
- Follower** - the gear or pulley that provides the output movement to the system.
- Mesh** - the point where two gears join together and transfer movement.
- Motor spindle** - the rod on the end of the motor onto which a gear or pulley is attached.

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<u>Connections / deepening understanding</u>	<u>RADE</u>	<u>Assessment</u>	
Linked to topic work in History	UNCRC – article 24		
Assessment recording for the unit - checking the level of pitch of the work			
<u>Key skill(s)/ knowledge to be assessed by the end of the unit</u>	<u>Lower attaining</u>	<u>Middle attaining</u>	<u>Higher attaining</u>
Key skills: Designing <ul style="list-style-type: none"> •Generate innovative ideas by carrying out research using surveys, interviews, questionnaires and web-based resources. •Develop a simple design specification to guide their thinking. •Develop and communicate ideas through discussion, annotated drawings, exploded drawings and drawings from different views. 	The pupils can Create a design to show the model they intend to make. Annotate this to explain the key elements of their idea.	The pupils can Develop an idea for a working vehicle and create a relevant, annotated, simple exploded diagram to show the key parts.	The pupils can Design a working vehicle and create a comprehensive exploded diagram which shows the key components for this. Annotate to show what elements will be included, materials which will be used and other key information.
Key skills: Making <ul style="list-style-type: none"> •Produce detailed lists of tools, equipment and materials. Formulate step-by-step plans and, if appropriate, allocate tasks within a team. •Select from and use a range of tools and equipment to make products that that are accurately assembled and well finished. •Work within the constraints of time, resources and cost. 	The pupils can Use simple tools and electrical components, with support, to create a simple moving vehicle.	The pupils can Use relevant tools and electrical components to create a moving vehicle, considering the aesthetics of their work as they make it.	The pupils can Use a range of tools and electrical components to create a working vehicle which show care and consideration to the aesthetics as well as the effectiveness of the design.
Key skills: Evaluating <ul style="list-style-type: none"> •Compare the final product to the original design specification. •Test products with intended user and critically evaluate the quality of the design, manufacture, functionality and fitness for purpose. •Consider the views of others to improve their work. •Investigate famous manufacturing and engineering companies relevant to the project. 	The pupils can Talk about their final design and model in terms of what works well and what could be improved. Make suggestions as to why / how this is the case.	The pupils can Carefully evaluate their finished product against their design brief. Discuss how their work meets this and how it may be improved. Discuss changes and adaptations that were made throughout the process to improve their final outcome.	The pupils can Evaluate their design brief against their final model and consider what has been successful. Think about what improvements could be made and why this would enhance the overall product. Discuss any adaptations that were made throughout the process and why these happened.
Key knowledge : Technical Skills <ul style="list-style-type: none"> •Understand that mechanical and electrical 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. 	The pupils can Explain, in simple terms, how their machine will move and be able to point out the parts which will assist the movement.	The pupils can Use their knowledge of gears and other mechanisms to explain how to make the moving parts for their model.	The pupils can Confidently explain, using the correct terminology, how gears will be used within their models to create movement. Link gears to prior learning of other mechanisms.

NB: The assessments are completed for two reasons – to enable the class teacher and in turn the subject leader to evaluate the pitch of the learning within the unit in order to consider any necessary updates and for the class teacher to report to parents on the attainment of pupils in the end of year reports.

Ideas / CPD:

Help sheet - T:\NEW server folder structure\1d. Year 6\2021-2022\Autumn\Design Technology – step by step guide to making from DATA

Video - <https://www.youtube.com/watch?v=gvPSInoDVCg> – shows step by step how to make a simple moving vehicle

Possible support for children:

How gears work - <https://www.youtube.com/watch?v=vX1-9C58-VM>

How do gears work? - <https://www.youtube.com/watch?v=4aI9f-ZKhEs>

How gears work for teachers - <https://www.youtube.com/watch?v=UPCugzIzLpY>

What is a pulley - <https://www.youtube.com/watch?v=LiBcur1aqcQ>

Need a lift? Try a pulley - <https://www.youtube.com/watch?v=Nj4J7QNeBNk>

Shopping list:

Elastic bands

Strong card

Glue / glue gun

Paper clips

Split pins

Straws

Cable ties

TTS

INVESTIGATION PACKS –

https://www.tts-group.co.uk/assorted-plastic-gears-60pk/GGO-GEARS.html?gclid=EAlaIqobChMIhanvyJzI8QIVaoBQBh2WIwRXEAQYASABEgl7-_D_BwE

<https://www.tts-group.co.uk/turn-learn-magnetic-gears/1018933.html>

Frame - Square section – <https://www.tts-group.co.uk/square-section-wood-packs/1000338.html>

Axles – circular dowel – <https://www.tts-group.co.uk/wooden-dowel-packs/1000318.html>

Pulleys – <https://www.tts-group.co.uk/assorted-plastic-pulleys-60pk/1003642.html>

Wheels – <https://www.tts-group.co.uk/wooden-wheel-packs/1000483.html>

Battery holders – <https://www.tts-group.co.uk/2-x-aa-battery-holders-with-leads/1003711.html>

Motor holders – <https://www.tts-group.co.uk/motor-mounting-clips/1003735.html>

Axle supports - <https://www.tts-group.co.uk/card-triangles-axle-supports/1000439.html>

Electrical wire – <https://www.tts-group.co.uk/connecting-wire/1003736.html>

Wire cutters - <https://www.tts-group.co.uk/wire-strippers/1003750.html>

Sandpaper – <https://www.tts-group.co.uk/sandpaper-25pk/1009368.html>

Motors – <https://www.tts-group.co.uk/small-electric-dc-motor-and-pulley-pack/1003734.html>

HEALTH AND SAFETY - AA zinc chloride batteries - <https://www.tts-group.co.uk/zinc-chloride-batteries/1013320.html>