

# 1. Year Groups

# Years 5/6

## 2. Aspect of D&T

# Mechanical systems

### Focus

## Pulleys or Gears

### 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.

### 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

### 7. Links to topics and themes

Festivals Celebrations Travel and Tourism  
Mini-enterprise Forces and Motion  
Outdoor adventure Toys and Games  
Our Community other – specify

### 5. Intended users

peers siblings younger children  
older children specific individuals  
target groups company other – specify

### 8. Possible contexts

home school leisure enterprise  
wider environment local community  
engineering manufacturing other – specify

### 6. Purpose of products

entertainment pleasure play  
educational interests and hobbies  
business other – specify

### 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.
- **Science** – 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.
- **Science** – 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.

### 10. Investigative and Evaluative 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 have 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.

### 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

### 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.

### 20. Overall potential of project

