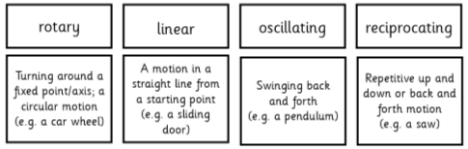
Mendell Primary School

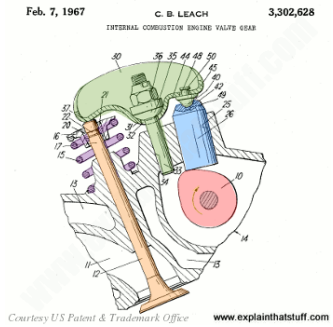
Aspire Challenge Achieve

Medium Term Plan Design Technology

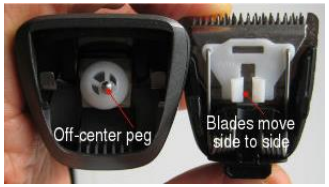
Year Group: 5	**Term:** Spring #2 2022	**Teacher:** Jordyn Keelan	**Subject lead:** Catherine O'Neill Edwards	**Overview:** **Mechanical Systems – CAMS** Design, make and evaluate an Easter themed toy that uses cams for someone at home	**Key end points:** **by the end of this unit children will be able to:** - Understand the mechanisms cams - Use cams in a product they will make

Links to other learning: Computing – use search technologies for research purposes and be discerning when evaluating digital content. • Science – forces and movement: explore the effects of simple machines on movement.	Prior Learning: Y1: Mechanisms; sliders and levers and simple structures Y2: Mechanisms; wheels and axles Y3: Mechanisms; levers & linkages Y4: Mechanisms: pneumatics & hydraulics	Future Learning: Y6: Mechanisms; gears & pulleys	High quality text: *'Easter Joke Book for Kids'* Major Giggle *'Easter Love Letters from God' Glenys Nellist*	**Risk Assessment:** Pupils should be taught to work safely, using tools, equipment, materials, components and techniques appropriate to the task. Personalised class risk assessments should be carried out prior to undertaking this project.	**Teacher CPD:** Please read the DATA project on a page sheets attached at the end of this plan prior to teaching. Cams are not to be confused with CAM (computer aided manufacture). Cams in the mechanical sense do not stand for anything – they are named a cam.

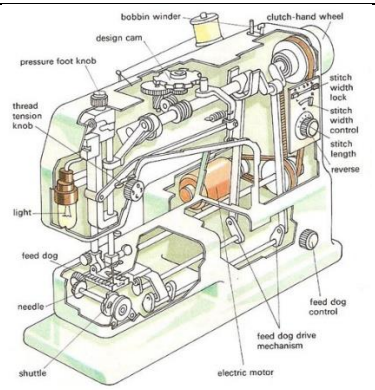
Learning Intention	Lesson Outline (Key Questions in colour)	Resources	Vocabulary	Lowest 20% Adaptations
I know what a CAM is	This is a DT lesson. In DT we design and make to solve problems. Recap prior learning: What is a mechanism? Allow children to discuss. *Something that does a job using moving parts.* Repeat aloud using 3 different voices (e.g. high, low, gruff) if children were not clear on this. The mechanisms we are going to be learning about this unit are cams. What is a cam? Allow discussion and any children that have any prior knowledge ask them to share with the class – they can draw examples if they need to. **A cam is a mechanism that transforms rotary motion into linear motion (or vice versa):** repeat 3/5 times – ask the person next to them Recite this phrase several times throughout the lesson and revisit regularly with the children as you explain what it means. In order to understand cams we need to learn some key vocabulary to understand different types of motion (movement): Rotary Linear Oscillating Reciprocating Children carry out matching activity matching definition to correct word – encourage discussion to explain thinking e.g. a linear motion is probably a line as linear and line are similar words. Discuss answers together: children stick in books. ANSWERS:  We are going to look at some cams now to help you understand these more. It is very difficult to see cams in real life as they are normally hidden inside machines. Share the following examples of cams:	- Vocabulary matching activity	**Cam** Rotary Linear Oscillating Reciprocating Follower	



Car engine



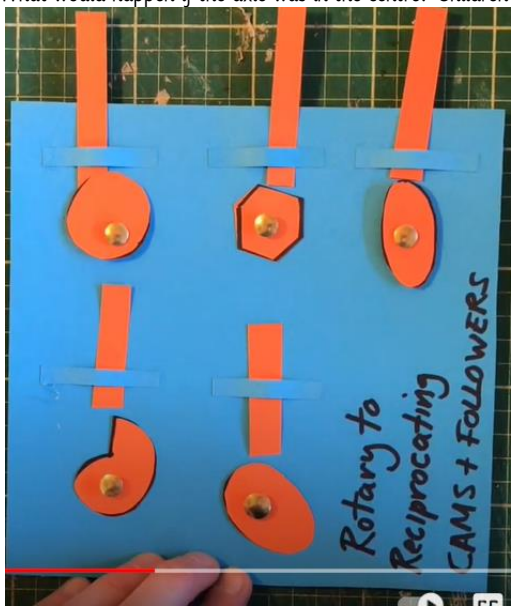
Hair Clippers



Sewing Machine

Let's learn more about cams by watching some videos that will help us see cams as they are moving: https://www.youtube.com/watch?v=tzWQasmUfLY stop the video at 2 minutes 14 seconds (the cams that appear after this time are too advanced). Turn the sound off as there is just back ground music. Each time a new image and explanation comes on pause, read through the explanation and discuss different types of movement referring back to vocabulary.

https://www.youtube.com/watch?v=v9uPiTmrr10 Watch this second video clip (starting at 28 seconds). This video clips shows different shaped cams and the various results in movement. The cams displayed are: eccentric, snail, hex, ellipse, egg. After the video has been watched, encourage children to recreate the paper versions of the cams to explore the different types of movement. We aren't going to recreate the hex cam –the ones the children should do are: eccentric, snail, ellipse and egg. Before children start ensure they are clear that an eccentric cam is one where the axle is off centre. What would happen if the axle was in the centre? Children could try this on their card version to see what happens.



Children create a cam card exploration as above (minus hex). Ask children to label: follower, axle, cam, housing, hole, high point and low point. Children than then check which are omnidirectional.

	Exit pass (children record in books): What is a mechanism? *Something that does a job using moving parts.* What is a cam? *A cam is a mechanism that transforms rotary motion into linear motion*			
I can use a G–clamp and a hand drill safely. I can use an annotated diagram to communicate my designs	This is a DT lesson. In DT we design and make to solve problems. In this lesson we are going to learn specific skills that will help us when making our cams. We will also be planning our designs. Focused Tasks (FTs) • Give children pre-cut cams made from MDF or wooden wheels to mount on a piece of board and observe their movement with a follower. • Demonstrate how to use a hand drill safely to make an off-centre cam and position it accurately in a housing. Ensure children secure the wheel with a G-clamp and use a piece of scrap wood under the wheel to avoid drilling through the bench hook or table. Stress the importance of measuring accurately and checking before cutting any holes or gluing. It is important to line up the cam and follower otherwise the mechanism may not work smoothly. How high will the cam lift the follower? The children's design booklet includes the following: Design, Make and Evaluate Assignment (DMEA) • Develop an authentic and meaningful design brief with the children. • Children generate innovative ideas and develop a design specification for their product, carefully considering the purpose and intended user for their product. • Communicate ideas through detailed, annotated diagrams. The drawings should indicate the design decisions made, including the location of the components, how they work as a system • Produce detailed step-by-step plans and lists of tools, equipment and materials needed. If appropriate, allocate tasks within a team. Before children start booklets discuss Diagrams: Share the following diagrams with the children and ask Do you know what each type of diagram is called?  **Labelled diagram** **Exploded Diagram** **Annotated diagram** **Cross sectional diagram,** Discuss the differences between annotated and labelled diagrams – annotated give further information. In your design pack, I want you to ensure you use annotated diagrams – make sure there is more information than on a labelled diagram. Work through the booklets with the children (see wagoll completed version)	G- clamps Spare/scrap wood cams Hand drill Dowel Box Design booklet (wagoll completed version for teacher CPD)	**Annotated diagram** Drawing Labelled Exploded Cross sectional G-clamp Drill Scrap wood Drill Hole axle	
I can use skills to make a working product	This is a DT lesson. In DT we design and make to solve problems. This lesson we will be making our products using the knowledge and skills we have already learned Children should use a range of decorative finishing techniques to ensure a well finished final product that matches the intended user and purpose. Ensure children are clear on what a 'product' means.	G- clamps Cams Cardboard boxes Dowelling Drills Resources to make characters/items for top of cam Lolly sticks	**Product**	

I know why evaluations are important and can evaluate effectively.	This is a DT lesson. In DT we design and make to solve problems. In this lesson we are evaluating our product. You should have been doing this as you went along. Did anyone do a dynamic evaluation and change anything about their design or product as they went along? Share ideas and examples. Discuss Why do we evaluate? Evaluation is really important – it is how you can make sure appropriate decisions have been made, correct action has been taken, and work has been done to the highest possible standard in line with its objectives. Where things don't work this is very important as it is how we learn. When we evaluate, we evaluate throughout and once the final product is finished, we compare 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. Children can start their evaluation once the product is completed. Some of the evaluation will need to be done after they have presented the product to the intended user.	Evaluation sheet	**Evaluation** Change improve Design User Product	

1. Year Groups

Years 5/6

2. Aspect of D&T

Mechanical systems

Focus

Cams

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 different types of movement.
- 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 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 the intended user, where safe and practical, 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 systems have an input, process and an output.
- Understand how cams can be used to produce different types of movement and change the direction of movement.
- Know and use technical vocabulary relevant to the project.

4. What could children design, make and evaluate?

a shop display with moving parts e.g. lifting or rotating images of items for sale
a vehicle incorporating cam-driven components
a toy with oscillating, rotating or reciprocating movement other – specify

5. Intended users

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

6. Purpose of products

business entertainment pleasure play
educational interests and hobbies
other – specify

7. Links to topics and themes

Toys and Games Our Community
Forces and Motion Mini-enterprise
Festivals Celebrations
other – specify

8. Possible contexts

shops home school local community
leisure enterprise wider environment
engineering manufacturing 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.

10. Investigative and Evaluative Activities (IEAs)

- Discuss with the children different types of movement: rotary, oscillating and reciprocating. Make simple models of different types of cams or have toys in which the cam mechanisms can be seen. Use videos, photographs and computer animations of products that cannot be explored through first-hand experience.
- Encourage children to look for different types of movement in the home and in school.
- Use observational drawings and questions to develop understanding of the products in the handling collection and those that children have researched 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 movement, process and output movement 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. car engine manufacturers

11. Related learning in other subjects

- **Spoken language** – ask relevant questions, formulate and express opinions, give well-structured descriptions and explanations. Listen and respond appropriately, articulate and justify answers, arguments and opinions. Consider and evaluate different viewpoints.
- **Computing** – use search technologies for research purposes and be discerning when evaluating digital content.
- **Science** – forces and movement: explore the effects of simple machines on movement.

12. Focused Tasks (FTs)

- Give children pre-cut cams made from MDF or wooden wheels to mount on a piece of board and observe their movement with a follower.
- Demonstrate how to use a hand drill safely to make an off-centre cam and position it accurately in a housing. Ensure children secure the wheel with a G-clamp and use a piece of scrap wood under the wheel to avoid drilling through the bench hook or table. Stress the importance of measuring accurately and checking before cutting any holes or gluing. It is important to line up the cam and follower otherwise the mechanism may not work smoothly. *How high will the cam lift the follower?*
- Develop measuring, marking, cutting, shaping and joining skills using junior hacksaws, G-clamps, bench hooks, square section wood, card triangles and hand drills to make cam mechanisms and construct wooden frames or card housings, as appropriate. Demonstrate the accurate and safe use of tools and equipment.

13. Related learning in other subjects

- **Spoken language** – listen and respond appropriately. Use relevant strategies to build their vocabulary.
- **Science** – identify and compare the suitability of a variety of everyday materials for particular uses.
- **Mathematics** – use mathematical vocabulary to describe position, direction and movement.

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 sketches from different views and/or exploded diagrams. The drawings should indicate the design decisions made, including the location of the components, how they work as a system 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.

15. Related learning in other subjects

- **Art and design** – use and apply drawing skills. Use techniques with colour, pattern, texture, line and shape.
- **Science** – explore the effects of simple machines on movement.
- **Mathematics** – choose and use appropriate standard units (i.e. cm/mm) to estimate and accurately measure length/height.

16. Possible resources

videos and photographs of cams, models or toys with different cam mechanisms

MDF, card or wooden wheels, plastic or wooden cams, dowel, card boxes, PVA glue, masking tape, double-sided tape, square section wood, card, corrugated plastic, finishing media

junior hacksaws, glass paper, G-clamps, bench hooks, hand drill

17. Key vocabulary

cam, snail cam, off-centre cam, peg cam, pear shaped cam

follower, axle, shaft, crank, handle, housing, framework

rotation, rotary motion, oscillating motion, reciprocating motion

annotated sketches, exploded diagrams

mechanical system, input movement, process, output movement

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

Years 5/6

Mechanical systems Cams

Instant CPD

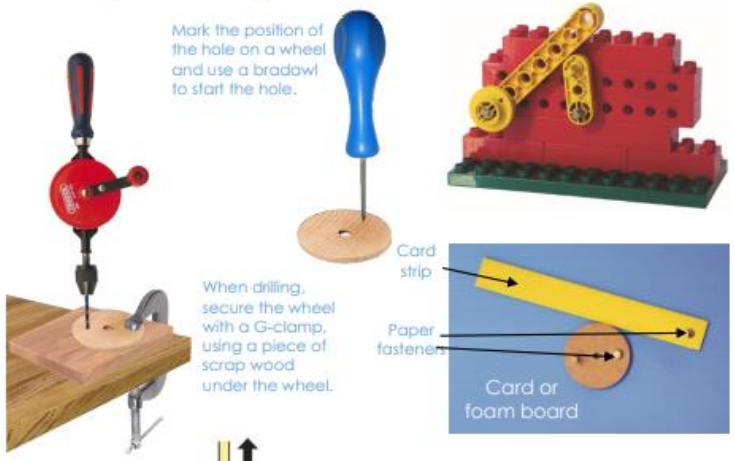
Tips for teachers

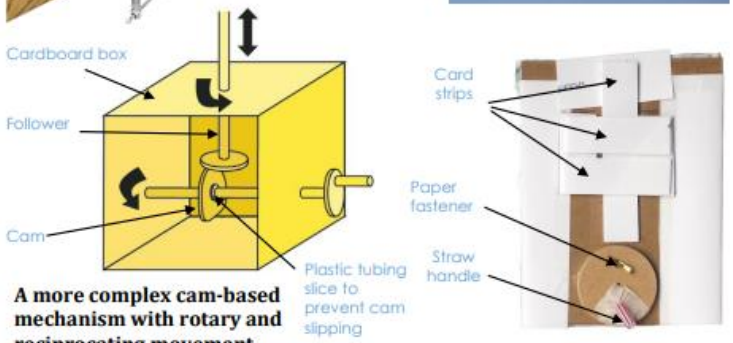
- ✓ Finding existing products that have cams on show can be difficult and they may have to be deconstructed to show the parts. Make example products using construction kits or consumable materials for children to investigate.
- ✓ Easy teaching aids can be made by mounting wheels on cardboard, foam board or corrugated plastic sheet. Card or foam wheels are easy to cut to different shapes.
- ✓ Avoid decorating teaching aids as this can influence the children's designs. Encourage discussion about what could move up and down and in rotation.
- ✓ Use pre-drilled wheels if time is limited and children have already had experience of using a hand drill.
- ✓ When making a cam and lever mechanism, remember the distance between the cam and the pivot point of the lever will affect the amount of movement, with more movement close to the pivot.
- ✓ When making a cam and slider mechanism, position the cam, slider and guides correctly. Measure where the cam will go to at the base of its cycle so that it does not overlap the bottom of the board. The guides should be positioned so that there is enough clearance for the cam to turn at the top of its cycle.
- ✓ 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 to include any failed designs into displays of final products. Include evaluations of why the 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.

Useful resources at www.data.org.uk

- Primary Subject Leaders' File Section 5.8
- Levers and Linkages
- Working with wheels and axles
- Mechanisms with a message
- Gears and Pulleys
- Fairgrounds

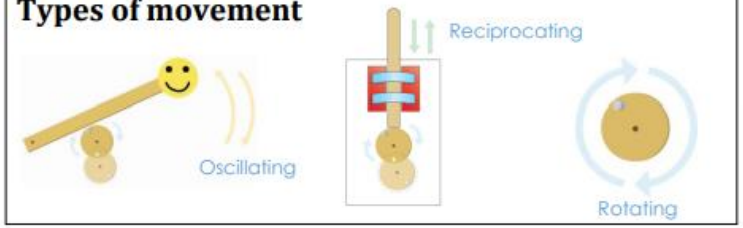
Making teaching aids to demonstrate cams



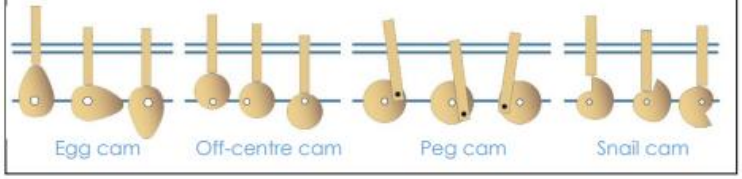


A more complex cam-based mechanism with rotary and reciprocating movement.

Types of movement



Types of cams



Designing, making and evaluating a moving toy 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 moving toy 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 type of movement will it have? Will it be a moving vehicle or be stationary and have moving parts?	Discussing, modelling and evaluating different systems using mechanical components
Which materials will I use to make it? How will I make it fit for purpose?	Investigating and trialling possible materials and components
How will I make the body or housing for the moving parts?	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

- **Rotary motion** – movement that goes round.
- **Oscillating motion** – moving to and fro around a pivot point, as in a lever.
- **Reciprocating motion** - backwards and forwards movement in a straight line, as in a slider.
- **Cam** – a mechanism that changes one sort of movement to another. Cams can be an off-centre wheel or a specially shaped wheel.
- **Follower** – the device that follows the movement of the cam: a lever or a slider.
- **Lever** – a piece of rigid material that moves to and fro around a pivot point creating oscillating motion.
- **Slider** – a piece of rigid material that moves backwards and forwards in a straight line creating reciprocating motion.
- **Guide** – a piece of material used to guide the movement of another.
- **Spacer** – a piece of material used to create extra space to allow moving parts to move freely.