Year 6 Autumn 2 – Summer 1 **Balloon Blaster** **Design and Technology (Model Making)**

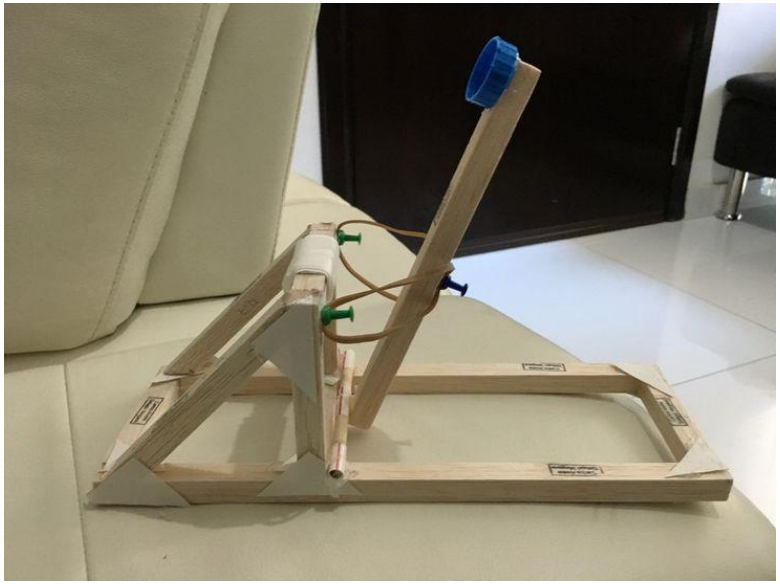
As Designers we will explore the use of catapults and examine the mechanisms involved. We will take part in the Plastic Spoon Catapult Challenge to see how far we can propel a chocolate Malteser, before creating a larger more stable catapult structure. We will explore how cams turn rotary motion into linear movement and we will experiment with the different types of cams in order to design and make a toy suitable for younger children. Finally, we will explore the main types of simple machines: inclined planes, levers, pulleys, wedges, and screws. We will find out the uses of each of them and we will take part in the Balloon Blaster Challenge, where we will be required to make a device (in the Rube Goldberg style) that uses all of these machines in order to pop a balloon.

NC Content

- develop the creative, technical and practical expertise needed to perform everyday tasks confidently and to participate successfully in an increasingly technological world
- build and apply a repertoire of knowledge, understanding and skills in order to design and make high-quality prototypes and products for a wide range of users
- critique, evaluate and test their ideas and products and the work of others
- understand and apply the principles of nutrition and learn how to cook.

Materials required for this unit:	**Tools and equipment required for this unit:**	**Vocabulary**
• A range of different wood • Card triangles (for joining) • Lollipop sticks • Elastic bands • Wooden circles and dowelling (for cams) • A range of alternative materials for creating toys and the balloon blaster. • Balloons	• Sandpaper • Markers and rulers for measuring • Wood glue • Clamps • Screws • Screwdrivers • Hand drill • Hack saws • Glue guns • Hammers • Nails	Lever Fulcrum Pivot Load Rotary Linear Cam Pulley Lever Wedge Plane Screw

Episode 1 – Catapult Challenge



https://www.youtube.com/watch?v=DwZA3WS2fB4
https://www.youtube.com/watch?v=KZHLYsFHLHw
https://www.youtube.com/watch?v=L79rlGVdZCQ

By the end of this learning sequence, children will know:

- About the history of different types of catapults, how they work and how they have changed.
- How levers work within a catapult and the vocabulary fulcrum, pivot, load and effort.
- How to create multiple cross-sectional diagrams to represent ideas with accurate measurements and explanations.
- How to measure, mark out and cut using junior hack saws with precision, finishing the cuts neatly.
- How to use wood glue/glue guns and joining triangles to create a precise join.
- How to create a working lever within a product.
- How to evaluate a product against the design criteria.

Research	Design	Make	Evaluate
Procedural skill: Combine elements of design from a range of inspirational designers	Procedural skill: Design with the user in mind, motivated by the service a product	Procedural skill: Develop a range of practical skills to create products (such as cutting,	Procedural skill:

throughout history, giving reason for choices. Create innovative designs that improve upon existing products. NC links: Pupils should be taught to: Understand how key events and individuals in design and technology have helped shape the world. Investigate and analyse a range of existing products Explore the history of catapults and their purposes (link to conflict topic). How have catapults changed throughout history? Give reasons for why. Explore the lever as a mechanism. Use this vocabulary when exploring levers: fulcrum, pivot, load, effort. This website may help and this one. Explore how a catapult works and the different types of catapults (ballista, trebuchet and mangonel) and identify their features (sling, bucket, restraining rope, cantilever-type spring, arm, rope etc.) How are the levers used in each catapult? Compare their effectiveness. Is one more effective than the other?	will offer (rather than simply for profit). Make products through stages of prototypes, making continual refinements. Ensure products have a high-quality finish, using art skills where appropriate. Use prototypes, cross-sectional diagrams and computer aided designs to represent designs. Develop a range of practical skills to create products (such as cutting, drilling and screwing, nailing, gluing, filing and sanding). Cut materials with precision and refine the finish with appropriate tools (such as sanding wood or making a more precise scissor cut after roughly cutting out a shape). NC Links: Pupils should be taught to: 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	drilling and screwing, nailing, gluing, filing and sanding). Cut materials with precision and refine the finish with appropriate tools (such as sanding wood or making a more precise scissor cut after roughly cutting out a shape). NC Links: Pupils should be taught to: 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. 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] Measure and mark out the required wooden pieces to the nearest mm.	Evaluate the design of products so as to suggest improvements to the user experience. NC Links: Pupils should be taught to: Evaluate their ideas and products against their own design criteria and consider the views of others to improve their work. Apply their understanding of how to strengthen, stiffen and reinforce more complex structures. Test the catapult and evaluate against the design criteria. Does it work as expected? Are there any issues? (e.g. the catapult may bounce/flip once released). How could the design be improved? Make adjustments to the product as required and re-test. Is the product more suitable/effective?

Why? Explore their design and frame and discuss how they could be recreated.	sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design. Design criteria: You are going to create a Roman-style catapult (mangonel) that can fire a ball across at least a 1m distance. The catapult should shoot the load with a force strong enough to knock down a Lego wall. Create a design for the base frame and the supporting arch, showing measurements (to the nearest mm) and joins (similar to in this video at 1:50, 4:42) as well as showing the design from a side view to show the supports and the catapult. Write the required tools and materials and write out a method of creating each section with an explanation of how the catapult will work. Create a prototype using lollypop sticks to explore how the lever mechanism will work and how the frame needs to be joined. Explain using Seesaw how it works. Make sure to use accurate vocabulary (bucket, payload, arm, rope, cantilever-type spring, frame,	Cut with precision using junior hack saws and clamps. Ensure cuts are straight and finish using sandpaper. Use wood glue and/or glue guns, joining triangles and clamps to join the pieces for each frame together. Use hammers and nails to attach the elastic for the cantilever-type spring. Use wood glue and/or glue guns and joining triangles to join all components of the catapult together.	

	fulcrum, pivot, load, effort). Make adjustments to the design as necessary as a result of exploring with the prototype.  Practise measuring, marking and sawing wood using junior hack saws. Ensure that cuts are straight by using a scriber or masking tape for marking. Place the wood inside a clamp to secure it and push the hacksaw forward to cut (the blade teeth will face forwards so the hacksaw will only cut on a forward push). Practise measuring and sawing at a 45 degree angle for the supports. Practise using sandpaper to finish the wood cuts.		

	Practise using wood glue and glue guns to join wood together and use joining triangles to ensure a right angle. Practise using hammers accurately on nails (to secure the elastic band to the wood creating the cantilever-type spring). Explore which materials are best suited to create the bucket. Explore methods of joining these to the wood.		

Episode 2 – We Are Smyths Toy Store

Using cams to convert rotary motion into linear motion to create a toy that travels in a straight line.

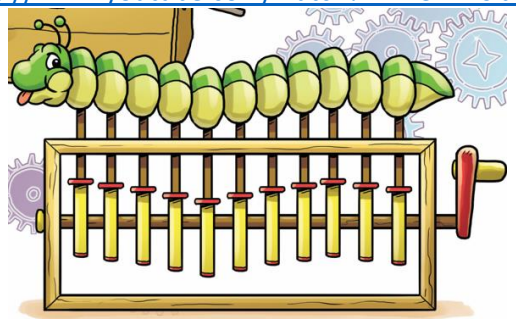
https://planbee.com/products/moving-toys#:~:text=They%20will%20learn%20that%20a,with%20cam%20mechanisms%20for%20themselves.

https://www.youtube.com/watch?v=tzWQasmUfLY

https://www.youtube.com/watch?v=2vCLmxsIavo

https://www.twinkl.co.uk/resource/t2-d-072-moving-toys-cam-mechanisms-lesson-teaching-pack

https://www.youtube.com/watch?v=2vCLmxsIavo&t



By the end of this learning sequence, children will:

- Know that cams are used to turn rotary motion into linear motion.
- Know the components of a cam and the different types.
- Know how to use real research to gage user interests and needs, and use this to inform the design when creating exploded diagrams.
- Use a range of tools (drills, hack saws, clamps, hammers) to measure and cut materials accurately, giving reasons for choice dependent on the material used.
- Use a range of joining methods appropriately, justifying the method dependent upon the materials used.
- Use the intended audience to evaluate their product, and make adjustments accordingly.

Research	Design	Make	Evaluate
Procedural skill: Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. Create innovative designs that improve upon existing products.	Procedural skill: Design with the user in mind, motivated by the service a product will offer (rather than simply for profit). Ensure products have a high-quality finish, using art skills where appropriate.	Procedural skill: Develop a range of practical skills to create products (such as cutting, drilling and screwing, nailing, gluing, filing and sanding). Cut materials with precision and refine the finish with appropriate tools (such as sanding wood or	Procedural skill: Evaluate the design of products so as to suggest improvements to the user experience. NC Links: Pupils should be taught to:

NC links: Pupils should be taught to: Understand how key events and individuals in design and technology have helped shape the world. Investigate and analyse a range of existing products Know that linear movement means moving in a straight line, up or down. Know that rotary movement is turning around in a circle. Explore how toys can use CAMS in order to move. Think about what is happening and how each of the parts are moving. Acknowledge that CAMS are used to turn rotary motion into linear motion. Explore the materials used to create toys using CAMS. Have these changed over time? Why do you think this is? Explore the three components of a cam mechanism (cam, slider and follower) and be able to explain how the three work together to create movement. Explore the different types of cams and know how these create	Use prototypes, cross-sectional diagrams and computer aided designs to represent designs. Develop a range of practical skills to create products (such as cutting, drilling and screwing, nailing, gluing, filing and sanding). Cut materials with precision and refine the finish with appropriate tools (such as sanding wood or making a more precise scissor cut after roughly cutting out a shape). Show an understanding of the qualities of materials to choose appropriate tools to cut and shape (such as the nature of fabric may require sharper scissors than those used to cut paper). NC Links: Pupils should be taught to: 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	making a more precise scissor cut after roughly cutting out a shape). Show an understanding of the qualities of materials to choose appropriate tools to cut and shape (such as the nature of fabric may require sharper scissors than those used to cut paper). Ensure products have a high-quality finish, using art skills where appropriate. NC Links: Pupils should be taught to: 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. 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]	Evaluate their ideas and products against their own design criteria and consider the views of others to improve their work. Apply their understanding of how to strengthen, stiffen and reinforce more complex structures. Test the product to ensure that it works as it should. Take back to the desired audience to gather feedback on functionality and design. Make adjustments to the product in accordance with the feedback, and evaluate against the design criteria.

different movements (round, egg-shaped, ellipse, eccentric, hexagon, snail).	computer-aided design. Design criteria: You are going to create a toy that is suitable for younger children. It must use at least 2 cams and have an appealing design. You must use research to form the base of your design. Explore with different materials that would be suitable to create a cam mechanism. Carry out research using surveys, interviews and questionnaires to identify the needs, wants and preferences of the target audience (younger children). Use this to inform design ideas. Create exploded diagrams (with accurate measurements) to communicate design ideas and be able to explain how the design will work, and also how it meets the needs/wants of the intended user. Practise measuring, marking and sawing wood using junior hack saws (or other appropriate cutting tools) on the range of materials required to create the toy.	Measure and mark out the required pieces to the nearest mm. Cut with precision using junior hack saws (or other appropriate cutting tools, dependent on the materials used) and clamps. Ensure cuts are straight and finish using sandpaper. Use drills to drill straight, accurately-sized holes for the cam mechanism. Use appropriate joining methods to join the materials together to create a strong, stable structure. Use hammers and nails (where appropriate/if necessary) to secure the frame for the toy.	

	Practise using sandpaper to finish the wood cuts. Practise using a range of joining methods to determine the best method for joining the different materials. (i.e. what is the best for joining wood, plastic, wire etc. where appropriate). Practise using hammers accurately on nails to ensure they are hammered in straight (where appropriate). Practise using junior drills to accurately drill straight holes into the wood (for the cam mechanism).		

Episode 3 – Balloon Blaster

We will explore the main types of simple machines: including planes, levers, pulleys, wedges and screws. We will find out the uses of each of them and we will take part in the Balloon Blaster Challenge, where we will be required to make a device that uses all of these machines in order to pop a balloon.

https://www.youtube.com/watch?v=D4b3RxUP2dk
https://www.youtube.com/watch?v=b-IDAgxl9Dk
https://www.youtube.com/watch?v=f7hb-aiU894

By the end of this learning sequence, children will:

- Know that Rube Goldberg is famous for his elaborate illustrations of complicated inventions to accomplish simple tasks.
- Be able to identify examples of Rube Goldberg-style inventions from films or the real world (e.g. Wallace and Gromit).
- Know how simple machines work (inclined planes, wedges, levers, pulleys and screws) and be able to replicate these when designing a product to accomplish a simple task.
- Be able to use a range of measuring, cutting, joining and finishing methods to combine mechanisms and create a product to accomplish a simple task.
- Evaluate a product against design criteria and make necessary adjustments.

Research	Design	Make	Evaluate
Procedural skill:	Procedural skill:	Procedural skill:	Procedural skill:

Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. Create innovative designs that improve upon existing products. NC links: Pupils should be taught to: Understand how key events and individuals in design and technology have helped shape the world. Investigate and analyse a range of existing products Research into Rube Goldberg's elaborate designs. Know that Rube Goldberg is famous for his elaborate illustrations of contraptions that combine a range of mechanical elements to accomplish simple tasks. Explore a range of examples of Rube Goldberg-style contraptions. (The children could play the game Mouse Trap – this is a classic example of the Rube Goldberg machine). Explore the main types of simple machines: including inclined planes, levers, pulleys, wedges and screws. (info and definitions and this	Design with the user in mind, motivated by the service a product will offer (rather than simply for profit). Make products through stages of prototypes, making continual refinements. Ensure products have a high-quality finish, using art skills where appropriate. Use prototypes, cross-sectional diagrams and computer aided designs to represent designs. Develop a range of practical skills to create products (such as cutting, drilling and screwing, nailing, gluing, filing and sanding). Cut materials with precision and refine the finish with appropriate tools (such as sanding wood or making a more precise scissor cut after roughly cutting out a shape). NC Links: Pupils should be taught to: 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.	Develop a range of practical skills to create products (such as cutting, drilling and screwing, nailing, gluing, filing and sanding). Cut materials with precision and refine the finish with appropriate tools (such as sanding wood or making a more precise scissor cut after roughly cutting out a shape). Show an understanding of the qualities of materials to choose appropriate tools to cut and shape (such as the nature of fabric may require sharper scissors than those used to cut paper). Ensure products have a high-quality finish, using art skills where appropriate. NC Links: Pupils should be taught to: 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 the design of products so as to suggest improvements to the user experience. NC Links: Pupils should be taught to: Evaluate their ideas and products against their own design criteria and consider the views of others to improve their work. Apply their understanding of how to strengthen, stiffen and reinforce more complex structures. Test that the product works as expected and meets the design criteria. Evaluate the product and make any necessary adjustments before re-testing.

website is useful too). How does each of them work? What materials can be used for each one?	Generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design. Design Criteria. You are going to make an elaborate machine to achieve the simple task of popping a balloon. You must consider how to combine a range of simple machines to achieve this outcome. The contraption must be simple to use. Experiment with combining each type of simple machine (inclined plane, lever, pulley, wedge and screw). In what order should the mechanisms be put together in order to achieve the outcome? Consider which materials, tools and joining methods are the most effective for the frame of the machine and then for each of the components. Justify reasoning. Create exploded diagrams (with accurate measurements and tools/materials required) to	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] Measure and mark out the required pieces to the nearest mm. Cut with precision using junior hack saws (or other appropriate cutting tools, dependent on the materials used) and clamps. Ensure cuts are straight and finish using sandpaper. Use drills to drill straight, accurately-sized holes (where necessary). Use appropriate joining methods to join the materials together to create a strong, stable structure. Use hammers and nails (where appropriate/if necessary). Use knowledge of how to stiffen and secure materials to create a sturdy structure with effective, working mechanisms.	

	demonstrate how the machine will work. Create a computer-aided design of the product using TinkerCad (Useful document in 365 to support using this). Practise measuring, marking and sawing wood using junior hack saws (or other appropriate cutting tools) on the range of materials required to create the machine. Practise using sandpaper to finish the wood cuts. Practise using a range of joining methods to determine the best method for joining the different materials. (i.e. what is the best for joining wood, plastic, wire etc. where appropriate). Practise using hammers accurately on nails to ensure they are hammered in straight (where appropriate). Practise using junior drills to accurately drill straight holes into the wood (where appropriate).		