Year 5 Autumn 2 – Summer 1 **Brilliant Bridges** **Design and Technology (Model Making)**

As Designers we will explore different types of bridges. We will look at their invention, how they have changed and the impact this has had upon the world. We will look at the designers of these bridges and how they are significant, and we will draw upon the research of existing bridges to create our own. We will design 3 different types of bridges and create step-by-step plans to create these. We will generate and communicate ideas using sketches and computer-aided design. When making our bridges, we will select the appropriate materials and tools and we will measure, cut, shape, join and finish with accuracy and precision. We will then evaluate our products against existing designs and the design criteria to determine whether they are fit for purpose.

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**
• Wooden dowels (differing thicknesses) • Square section wood (squared dowel) • Card triangles (for joining) • Assorted Balsa wood/standard wood packs • Board bases • Wire/string • Sugar cubes (arch prototype) • Card/cardboard for prototypes • Lollipop sticks for prototypes/design ideas	• Sandpaper • Markers and rulers for measuring • Wood glue • Clamps • Screws • Screwdrivers • Hand drill • Hack saws	Adjustments Finishing computer-aided design prototype compression suspension refine tension

Episode 1 – Arches (compression and tension)

https://www.bigrentz.com/blog/types-of-bridges#arch-bridge

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

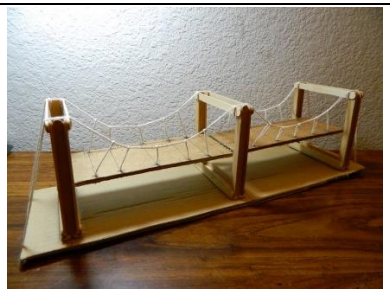
- How an arch bridge can support a weight and the impact of compression and tension. (Using scientific knowledge to make products that work)
- How to generate ideas for design through annotated sketches and computer-aided design.
- How to formulate a step-by-step plan including a list of tools, equipment and materials that they need.
- Which materials are the most effective for creating an arch bridge, and children will know how to measure, cut, shape, join and finish these using appropriate tools with accuracy.
- How to evaluate a product against its design criteria, and suggest improvements drawing upon an understanding of how to strengthen, stiffen and reinforce structures.

Research	Design	Make	Evaluate
Procedural skill: Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. 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.	Procedural skill: 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. Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. Create innovative designs that improve upon existing products. Use prototypes, cross-sectional diagrams and computer aided designs to represent designs. NC Links: Pupils should be taught to:	Procedural skill: Materials 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). Construction Develop a range of practical skills to create products (such as cutting,	Procedural skill: Evaluate the design of products so as to suggest improvements to the user experience. NC Links: Pupils should be taught to: 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

Understand how key events and individuals in design and technology have helped shape the world. • Research into different buildings that have arches. Identify famous buildings and structures through time that use arches (link to Roman aqueducts) Compare these structures and the materials used to create them. • Research into why the arch creates a strong and stable structure in comparison to just a flat bridge. Use real life structures to do this and identify the differences in strength. • When was the first arch bridge invented? Who by? How did the invention of this bridge type change the world? • How has the design of an arch bridge change? Consider changes in materials and why these changes have occurred. • Explore how the compression and tension forces work together to create a stable structure. • Describe how an arch is made in order to support weight.	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 Design Criteria: Create an arch bridge that can support the weight of 3 toy cars and can withstand a weather simulation. Your bridge must span a distance of at least 20cm and be able to allow the toy cars to pass over it. • Design and label a plan to create an arch prototype out of sugar cubes. Children need to carefully consider how the design needs to be made up to ensure the correct amount of compression and tension. • Create an arch structure using sugar cubes. • Test the structure by balancing a weight on top – this could be progressive. Compare whose structures are the strongest and begin to give reasons for why. • Use understanding from creating a prototype to create a design for an arch bridge and label this with the key features.	drilling and screwing, nailing, gluing, filing and sanding). NC Links: Pupils should be taught to: 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 apply their understanding of how to strengthen, stiffen and reinforce more complex structures Make the arch bridge following the designs. This bridge must be fit for purpose (see design criteria) and must use typical arch bridge methods.	technology have helped shape the world. apply their understanding of how to strengthen, stiffen and reinforce more complex structures . Test the bridge by moving various objects across it to test if it can withstand the weight. If the bridge fails the test, what needs to be adjusted to improve effectiveness? Children to evaluate the effectiveness of the bridge and make adjustments where necessary, giving reasons for their changes.

• Label the different parts of an arch. • Possible visit to an arch bridge.	Consider materials used and joining methods. (Wood, wood glue, saws, cutting) • Test a range of materials (wire, wood, dowelling, card) that could be used to create an arch bridge. Compare and contrast in terms of effectiveness. How can these be strengthened? Explore methods of marking, cutting, joining and finishing these materials. Which tools are the most suitable for this? • Generate ideas for design using annotated sketches and computer-aided design. (https://www.tinkercad.com) (This unit on TC might help with subject knowledge: https://teachcomputing.org/curriculum/key-stage-2/creating-media-3d-modelling) • Design and label a step-by-step plan to create an arch bridge. The plan should include exact measurements to the nearest 1mm, tools required, joining and strengthening methods, and materials that will be used.		

Episode 2 – Suspension Bridge



https://www.bigrentz.com/blog/types-of-bridges#suspension-bridge

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

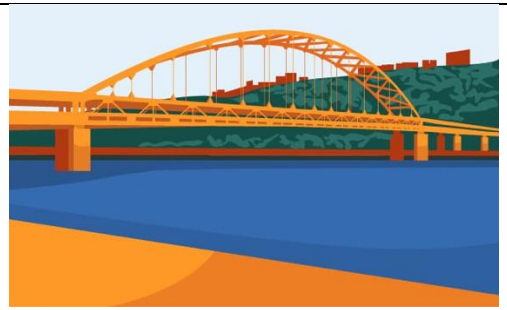
- How a suspension bridge can support a weight and what can happen during high winds. (Using scientific knowledge to make products that work)
- How to generate ideas for design through annotated sketches and computer-aided design.
- How to formulate a step-by-step plan including a list of tools, equipment and materials that they need.
- Which materials are the most effective for creating a suspension bridge, and children will know how to measure, cut, shape, join and finish these using appropriate tools with accuracy.
- How to evaluate a product against its design criteria and suggest improvements drawing upon an understanding of how to strengthen, stiffen and reinforce structures.

Research	Design	Make	Evaluate
Procedural skill: Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. 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.	Procedural skill: 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. Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. Create innovative designs that improve upon existing products. Use prototypes, cross-sectional diagrams and computer aided designs to represent designs.	Procedural skill: Materials 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). Construction Develop a range of practical skills to create products (such as cutting, drilling	Procedural skill: Evaluate the design of products so as to suggest improvements to the user experience. NC Links: Pupils should be taught to: 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. • Research into different suspension bridges around the world. What are they suitable for? How do these compare to an arch bridge? (i.e. is one more suitable to heavier loads/longer distances?) • When was the first suspension bridge invented? Who by? How did the invention of this bridge type change the world? • Most suspension bridges were made of simple rope to support wooden planks. How has this changed? Why did this change occur? Consider the strength and overall effectiveness of the materials (i.e. ability to withstand bad weather) • What happens to these bridges in high winds? What problems can this cause for motorists? Explore how the impact of torsion on the suspension bridge. • Describe how a suspension bridge is made in order to support weight. How are they stabilised? • Label the different parts of a suspension bridge.	NC Links: Pupils should be taught to: 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 apply their understanding of how to strengthen, stiffen and reinforce more complex structures Design Criteria: Create a suspension bridge that can support the weight of 3 toy cars and can withstand a weather simulation. Your bridge must span a distance of at least 50cm and be able to allow the toy cars to pass over it. • Test a range of materials (wire, wood, dowelling, card) that could be used to create a suspension bridge. Compare and contrast in terms of effectiveness. How can these be strengthened?	and screwing, nailing, gluing, filing and sanding). NC Links: Pupils should be taught to: 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 apply their understanding of how to strengthen, stiffen and reinforce more complex structures Create a suspension bridge according to the plan. This bridge must be fit for purpose (see design criteria) and must use typical suspension bridge methods.	Understand how key events and individuals in design and technology have helped shape the world. apply their understanding of how to strengthen, stiffen and reinforce more complex structures . Test the bridge by moving various objects across it to test if it can withstand the weight. If the bridge fails the test, what needs to be adjusted to improve effectiveness? Children to evaluate the effectiveness of the bridge and make adjustments where necessary, giving reasons for their changes.

• Visit to the Humber Bridge. A trip on the minibus across the bridge and stop at Hessle Foreshore to spot the different features etc. Can we organise a talk with someone who works for the council??	Explore methods of marking, cutting, joining and finishing these materials. Which tools are the most suitable for this? • Research methods of creating suspension bridges and investigate with how to join and strengthen these. (i.e. gluing sheets of card together to make them more sturdy, twisting the wire etc.) • Generate ideas for design using annotated sketches and computer-aided design. (https://www.tinkercad.com) • Design and label a step-by-step plan to create a suspension bridge. The plan should include exact measurements to the nearest 1mm, tools required, joining and strengthening methods, and materials that will be used.		

Episode 3 – Tied Arch bridge



https://www.bigrentz.com/blog/types-of-bridges#tied-arch-bridge

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

- How a tied arch bridge can support a weight. (Using scientific knowledge to make products that work)
- How to generate ideas for design through annotated sketches and computer-aided design.
- How to formulate a step-by-step plan including a list of tools, equipment and materials that they need.
- Which materials are the most effective for creating a tied arch bridge, and children will know how to measure, cut, shape, join and finish these using appropriate tools with accuracy.
- How to evaluate a product against its design criteria, and suggest improvements drawing upon an understanding of how to strengthen, stiffen and reinforce structures.

Research	Design	Make	Evaluate
Procedural skill: Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. 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.	Procedural skill: 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. Combine elements of design from a range of inspirational designers throughout history, giving reason for choices. Create innovative designs that improve upon existing products. Use prototypes, cross-sectional diagrams and computer aided designs to represent designs.	Procedural skill: Materials 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). Construction Develop a range of practical skills to create products (such as cutting, drilling	Procedural skill: Evaluate the design of products so as to suggest improvements to the user experience. NC Links: Pupils should be taught to: 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. • Research into different tied arch bridges around the world. What are they suitable for? How do these compare to an arch/suspension bridge? (i.e. is one more suitable to heavier loads/longer distances?) How does the tied arch bridge draw upon features from both the arch and suspension bridges? • When was the first tied arch bridge invented? Who by? How did the invention of this bridge type change the world? • Consider the impact of weather on a tied arch bridge compared to the impact of a suspension bridge. Is one more resistant than the other? • Describe how a tied arch bridge is made in order to support weight. How are they stabilised? • Label the different parts of a tied arch bridge. • Visit to the Murdoch's Connection Bridge (over the A63 in the city centre). Can we organise a talk with someone who works for the council??	NC Links: Pupils should be taught to: 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 apply their understanding of how to strengthen, stiffen and reinforce more complex structures Design Criteria: Create a tied arch bridge that can support the weight of 3 toy cars and can withstand a weather simulation. Your bridge must span a distance of at least 50cm and be able to allow the toy cars to pass over it. • Test a range of materials (wire, wood, dowelling, card) that could be used to create a tied arch bridge. Compare and contrast in terms of effectiveness against the	and screwing, nailing, gluing, filing and sanding). NC Links: Pupils should be taught to: 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 apply their understanding of how to strengthen, stiffen and reinforce more complex structures Create a tied arch bridge according to the plan. This bridge must be fit for purpose (see design criteria) and must use typical tied arch bridge methods.	Understand how key events and individuals in design and technology have helped shape the world. apply their understanding of how to strengthen, stiffen and reinforce more complex structures . Test the bridge by moving various objects across it to test if it can withstand the weight. If the bridge fails the test, what needs to be adjusted to improve effectiveness? Children to evaluate the effectiveness of the bridge and make adjustments where necessary, giving reasons for their changes.

	design criteria. How can these materials be strengthened? Explore methods of marking, cutting, joining and finishing these materials. Which tools are the most suitable for this? • Research methods of creating tied arch bridges and investigate with how to join and strengthen these. (i.e. gluing sheets of card together to make them more sturdy, twisting the wire etc.) • Generate ideas for design using annotated sketches and computer-aided design. (https://www.tinkercad.com) • Design and label a step-by-step plan to create a tied arch bridge. The plan should include exact measurements to the nearest 1mm, tools required, joining and strengthening methods, and materials that will be used.		