

Learning journey	Design Technology	Structures - Bridges	Year 5 – Spring	
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Building on prior learning	Theme overview	Preparing for future learning	Vocabulary	
<p>In Year 4, children will learn to:</p> <p>Design:</p> <ul style="list-style-type: none"> •Generate realistic ideas and design criteria collaboratively through discussion, focusing on the needs of the user and purpose of the product. •Develop ideas through the analysis of existing products and use annotated sketches and prototypes to model and communicate ideas. <p>Making:</p> <ul style="list-style-type: none"> •Order the main stages of making. •Use appropriate tools to measure, mark out, cut, score, shape and assemble with some accuracy. •Explain their choice of materials according to functional properties and aesthetic qualities. •Use finishing techniques suitable for the product they are creating. <p>Evaluating:</p> <ul style="list-style-type: none"> •Investigate and evaluate a range of existing shell structures including the materials, components and techniques that have been used. •Test and evaluate their own products against design criteria and the intended user and purpose. <p>Technical skills:</p> <ul style="list-style-type: none"> •Develop and use knowledge of how to construct strong, stiff shell structures. •Develop and use knowledge of nets of cubes and cuboids and, where appropriate, more complex 3D shapes. •Know and use technical vocabulary relevant to the project. 	<p>The pupils will know: How to join materials and combine materials to enhance their properties.</p> <p>The pupils will study: A range of joining and fixing techniques which can be incorporated in to their design.</p> <p>They will learn: How to incorporate different materials and their properties to develop a final product.</p> <p>They will investigate: How various structures have been made and how material, cost, time, and other factors can have a significant impact on this.</p>	<p>In KS3, children will learn to:</p> <p>Design:</p> <ul style="list-style-type: none"> · use research and exploration, such as the study of different cultures, to identify and understand user needs · 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:</p> <ul style="list-style-type: none"> · select from and use specialist tools, techniques, processes, equipment and machinery precisely, including computer-aided manufacture · select from and use a wider, more complex range of materials, components and ingredients, taking into account their properties <p>Evaluating:</p> <ul style="list-style-type: none"> · analyse the work of past and present professionals and others to develop and broaden their understanding · 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:</p> <ul style="list-style-type: none"> · understand and use the properties of materials and the performance of structural elements to achieve functioning solutions · 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>frame structure stiffen strengthen reinforce triangulation stability shape join temporary permanent</p>	<p>design brief design specification prototype annotated sketch purpose user innovation research functional</p>

NC coverage and HWJS skills development

National curriculum coverage for Design and Technology
Pupils should be taught to:

Key stage 2

· 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 materials and components, including construction materials, textiles and ingredients, according to their functional properties and aesthetic qualities

Evaluate

· evaluate their ideas and products against their own design criteria and consider the views of others to improve their work

Technical knowledge

· apply their understanding of how to strengthen, stiffen and reinforce more complex structures

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

HWJS skills development

Design:

- Carry out research into user needs and existing products, using surveys, interviews, questionnaires and web-based resources.
- Develop a simple design specification to guide the development of their ideas and

Knowledge organisers

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
Structures
Focus
Frame structures

4. What could children design, make and evaluate?
playground shelter market stall bus shelter tent play house gazebo bird hide parasol park furniture adventure playground equipment kite other – specify

5. Intended users
themselves parents younger/older children local community walkers market trader gardeners mountaineers bird watchers other – specify

6. Purpose of products
safety weather protection play pleasure meeting place business recreation other – specify

16. Possible resources
products, photographs, web-based resources of existing frame structures

17. Key vocabulary
frame structure, stiffen, strengthen, reinforce, triangulation, stability, shape, join, temporary, permanent

card, paper straws, newspaper, square sectioned wood, masking tape, PVA glue, pencils, rulers, right/left handed scissors, bench hooks, G-clamp, junior hacksaws, glass paper

design brief, design specification, prototype, annotated sketch, purpose, user, innovation, research, functional

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

7. Links to topics and themes
Shape and Space Festivals Celebrations Our School Toys and Games Outdoors Our Local Community Weather Countries and Cultures other – specify

8. Possible contexts
home school gardens leisure culture local community wider environment 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)

- Children investigate and make annotated drawings of a range of portable and permanent frame structures, e.g. tents, bus shelters, umbrellas. Use photographs and web-based research to extend the range e.g. *How well does the frame structure meet users' needs and purposes? Why were materials chosen? What methods of construction have been used? How has the framework been strengthened, reinforced and stiffened? How does the shape of the framework affect its strength? How innovative is the design? When was it made? Who made it? Where was it made?*
- Children could research key events and individuals related to their study of frame structures e.g. Stephen Sauvestre – a designer of the Eiffel Tower; Thomas Farnolls Pritchard – designer of the Iron Bridge. They could also learn about locally important design and technology activity related to their project.

11. Related learning in other subjects

- **Science** – compare and group together everyday materials on the basis of their properties.
- **Mathematics** – identify 3-D shapes, including cubes and other cuboids, from 2-D representations.
- **Spoken language** – ask relevant questions, formulate and express opinions, give well-structured descriptions and explanations. Use relevant strategies to build their vocabulary.
- **Computing** – use technologies for research purposes and be discerning when evaluating digital content.

12. Focused Tasks (FTs)

- Use a construction kit consisting of plastic strips and paper fasteners to build 2-D frameworks. Compare the strength of square frameworks with triangular frameworks. Ask the children to reinforce square frameworks using diagonals to help develop an understanding of using triangulation to add strength to a structure.
- Demonstrate how paper tubes can be made from rolling sheets of newspaper diagonally around pieces of e.g. dowel. Ask children to use these tubes and masking tape or paper straws with pipe cleaners to build 3-D frameworks such as cubes, cuboids and pyramids. *How could each of the frameworks be reinforced and strengthened?*
- Demonstrate the accurate use of tools and equipment. Develop skills and techniques using junior hacksaws, G-clamps, bench hooks, square section wood, card triangles and hand drills to construct wooden frames, as appropriate.
- Demonstrate skills and techniques for accurately joining framework materials together e.g. paper straws, square sectioned wood. Ask children to practise these, mounting their joints onto card for future reference.

13. Related learning in other subjects

- **Mathematics** – recognise, describe and build simple 3-D shapes. Apply understanding and skill to carry out accurate measuring using standard units i.e. cm/mm.
- **Spoken language** – ask relevant questions, formulate and express opinions, give well-structured descriptions and explanations. Use strategies to build their vocabulary.

14. Design, Make and Evaluate Assignment (DMEA)

- Discuss the brief of designing and making a small-scale frame structure e.g. *Who is the intended user and what is the purpose of the frame structure? Will it be permanent, or can it be easily dismantled? What materials will you use? How will it be joined? How will it be reinforced? How will it be finished?* Children should be encouraged to generate innovative ideas, drawing on their research. Ask children to develop a simple design specification to guide their thinking.
- Children should produce a detailed, step-by-step plan, listing tools and materials.
- Children's sketches should be annotated with notes to help develop and communicate their ideas.
- Encourage children to model their ideas first using materials such as paper, card and paper straws e.g. *How will you make it stable? How will it stand up? How could you make it stronger? Where are the weak points? How could you reinforce them? What tools and materials will you need? How can you improve the design?*
- Encourage children to make their products with accuracy. They should regularly evaluate their work and their completed product, drawing on their design specification, and thinking about the intended purpose and user.

15. Related learning in other subjects

- **Spoken language** – ask relevant questions, formulate and express opinions, give well-structured descriptions and explanations. Use strategies to build their vocabulary.
- **Art and design** – use and develop drawing skills.
- **Mathematics** – apply understanding and skill to carry out accurate measuring using standard units i.e. cm/mm.

products, taking account of constraints including time, resources and cost.

●Generate, develop and model innovative ideas, through discussion, prototypes and annotated sketches.

Making:

●Formulate a clear plan, including a step-by-step list of what needs to be done and lists of resources to be used.

●Competently select from and use appropriate tools to accurately measure, mark out, cut, shape and join construction materials to make frameworks.

●Use finishing and decorative techniques suitable for the product they are designing and making.

Evaluating:

●Investigate and evaluate a range of existing frame structures.

●Critically evaluate their products against their design specification, intended user and purpose, identifying strengths and areas for development, and carrying out appropriate tests.

●Research key events and individuals relevant to frame structures.

Technical skills:

●Understand how to strengthen, stiffen and reinforce 3-D frameworks.

●Know and use technical vocabulary relevant to the project.

Years 5/6 Structures Frame structures

Instant CPD



Tips for teachers

- ✓ Collect a range of photographs of different frame structures, both portable and permanent e.g. tents, bus shelters, bird hides.
- ✓ Include examples constructed with external and internal frameworks.
- ✓ Record the process of investigating frame structures using photographs and annotated drawings.
- ✓ Take children on a local 'frame structures' trail to help them get ideas for their own products and understand construction techniques.
- ✓ Frame structures for large scale shelters can be made from broom sticks, garden canes or rolls of newspaper.
- ✓ Ensure children are familiar with all the materials they are likely to use and that these are made easily available and accessible.
- ✓ Discuss constraints such as time, resources and cost.
- ✓ Display technical vocabulary and encourage children to use it when discussing, designing and making their product.
- ✓ Ensure children use simple tests to evaluate the functionality and strength of their products.
- ✓ Encourage the children to evaluate each other's work positively.

- Useful resources at www.data.org.uk
- Bird Hides Dragons' Den Challenge
 - Let's Get Practical poster* Working with paper straws
 - CPD Resources Primary Inset Guides
- Other useful web-based resources*
- <http://education.staffordshire.gov.uk/Curriculum/Subjectarea/as/DesignandTechnology/Primary/Support/Datafile/>
- D&T Association publications*
- Primary Helpsheets - Unit 6A Shelters
 - Primary Lesson Plans - Unit 6A Shelters
- Please note that these publications are based on previous National Curricula.

Techniques for building frame structures

Roll paper to make tubes for construction

Joining straws

- Drinking straw
- Plastic tubing
- Threaded and tied
- Pipe cleaner
- Straws split to fit round then glued
- Straw flattened, wrapped around and glued
- Glued to card
- Ends of straws flattened and glued
- One straw crossed and inserted flattened and glued
- Pipe cleaner
- Sleeve glued around joint
- Stricky tape

Joining thin sectioned pieces of wood

- Card strips can be used to make joints (Use PVA glue)
- Elastic bands or string can be used to make joints
- Card triangles can be used to make joints

Understanding triangulation

Creating triangles for rigidity

More rigid

Making small-scale frame structures

Using straws

Using square section wood

Card

Blue - use sparingly

Card corners

Designing and making a small-scale bird hide for children to use in the school wildlife area

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 structure shall I make? What will be its purpose? Who will use it?	Discussing ideas, drawing annotated sketches Generating a simple design specification
Which will be the best shape for my bird hide? What features will it have?	Discussing, modelling and evaluating different options
Which materials will I use to make it? How will I make it strong and waterproof?	Investigating and testing possible materials Discussing, exploring and evaluating prototypes
What will I use to cover the structure of my shelter?	Discussing, exploring and evaluating different fabric and rigid covering options
What tools and materials will I need? What order will I work in? Will I work with someone? What constraints I am 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 of the user?	Evaluating the product with the intended user and against the original design specification

- Glossary**
- Modelling - the process of making a 3-D representation of a structure or product.
 - Compression - the application of pressure to squeeze an object.
 - Strut - a part of a structure under compression.
 - Tension - a force pulling on a material or structure.
 - Tie - a part of a structure under tension.
 - Diagonal - a straight line that goes from one corner to another inside a shape.
 - Horizontal - a line that is parallel to the ground.
 - Vertical - a line that is at right angles to the ground.
 - Triangulation - the use of triangular shapes to strengthen a structure.
 - Frame structure - a structure made from thin components e.g. tent frame.

<u>Connections / deepening understanding</u>	<u>RADE</u>	<u>Assessment</u>	
Unit linked to Geography topic of sustainability	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"> Develop a simple design specification to guide the development of their ideas and products, taking account of constraints including time, resources and cost. 	The pupils can Develop some potential ideas to help them create a bridge.	The pupils can Consider the design brief and develop their own idea for a design based on what they have seen.	The pupils can Create a relevant and considered design for their product and explain their choices or inspiration.
Key skills: Making <ul style="list-style-type: none"> Formulate a clear plan, including a step-by-step list of what needs to be done and lists of resources to be used. 	The pupils can Show an understanding of the process they will need to follow in order to create their product.	The pupils can Create a step-by-step plan for what they are making and explain the need for the order they have chosen.	The pupils can Create a clear and considered plan for their own product and explain how it will be made in simple, logical steps.
Key skills: Evaluating <ul style="list-style-type: none"> Investigate and evaluate a range of existing frame structures. Research key events and individuals relevant to frame structures. 	The pupils can Look at pictures of existing structures and talk about how they are made (materials, joins, shapes, etc.)	The pupils can Complete some research around structures, considering techniques which can be used and how these may relate to their own product.	The pupils can Research a range of pre-existing structures, discussing how they were created. Use this information to support their own design of a product.
Key knowledge : Technical Skills <ul style="list-style-type: none"> Understand how to strengthen, stiffen and reinforce 3-D frameworks. 	The pupils can Explain why there is a need to change some materials or combine materials in order to develop their properties.	The pupils can Suggest a number of ways in which structures could be strengthened and which they have chosen to use and why.	The pupils can Confidently explain their options when they have the need to develop and strengthen the properties of their materials.

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.