

Year 5 Design and Technology: Structures – Block E

How are frames strengthened, reinforced and made rigid?

• The outline and structure of the block is as follows:

Lesson 1	Lesson 2	Lesson 3		At the end of this block, pupils will		
Identification of the problem	Explicit teaching of	Application of skills		Know:	Be able to:	
Exploring materials	skills relating to the brief	Evaluation and adaptation		Engineers use a range of methods to strengthen and	Identify and describe ways that frames are strengthened and	
			-	reinforce	reinforced	



Abraham Darby III (1750 – 1789) Iron Bridge (1779) In this unit, pupils will look at a range of ways that frames are reinforced to

structures

make them stable.

They will identify joins and supports and create a model shelter based on what they have learnt.

CUSP Design & Technology Long term sequence	Block A	Block B	Block C	Block D	Block E	Block F
Year 1	Mechanisms	Structures	Food and Nutrition	Understanding Materials	Textiles	Food and Nutrition
Year 2	Textiles	Food and Nutrition	Mechanisms	Understanding Materials	Food and Nutrition	Structures
Year 3	Textiles	Food and Nutrition	Mechanisms	Food and Nutrition	Systems	Structures
Year 4	Food and Nutrition	Mechanisms	Textiles	Structures	Electrical Systems	Food and Nutrition
Year 5	Food and Nutrition	Systems	Textiles	Mechanisms	Structures	Food and Nutrition
Year 6	Food and Nutrition	Mechanisms	Food and Nutrition	Structures	Electrical Systems	Textiles



Point of reference: Y5 Structures – Block E

Pupils will be able to:

 identify shapes suitable for adding strength to a structure



 identify some methods used to provide structural stability

Design or Technology History:

Abraham Darby III (1750 – 1789)

Abraham Darby III was an English ironmaster and Quaker. He was the third man of that name in several generations of an English Quaker family that played a pivotal role in the industrial revolution. At age thirteen, Darby inherited his father's shares in the family iron-making businesses in the Severn Valley and in 1768, aged eighteen, he took over the management of the Coalbrookdale ironworks. He built the largest cast iron structure of his era – the first cast iron bridge ever built, as a crossing over the Severn near Coalbrookdale.

Links to Literature:

13 Buildings Children Should Know by Annette Roeder From Mud Huts to Skyscrapers by Christine Paxmann Cool Architecture by Simon Armstrong How Was That Built? by Roma Agrawal

Materials:

Approximately 50cm lengths of square (1cm) ended balsa wood (1 per pupil), corrugated cardboard, A4 cardstock (1 per pupil), hacksaws, bench block or mitre block, craft sticks, images of framed structures and joins, PVA glue.

Health and Safety:

This block requires pupils to use: hacksaws, wood, PVA glue and bench blocks. Teachers should ensure that they follow their own school's risk assessments and policies for using the necessary materials and equipment. Pupils should be taught about how to use equipment and materials safely and responsibly as part of these lessons.

Working as a Designer						
Design Make Evaluate Apply						
The art or process of deciding how something will look or work.	Create something by combining materials or putting parts together.	Form an opinion of the value or quality of something after careful thought.	Use something or make something work in a particular situation.			



Supporting images: Y5 Structures – Block E





Supporting images: Y5 Structures – Block E



Anderson and Morrison Shelters

Whereas the Anderson shelter was designed for use outside, the Morrison shelter was constructed inside homes and were often disguised as a dining table for everyday use!

The Anderson shelter had specific dimensions for being partially buried and had earth heaped on top of the roof, not only to add protection from a blast, but so that it could be used for growing plants or vegetables on top. The shelter was cold, could get flooded and was noisy during a raid.

The Morrison shelter, although built within the house and a functional piece of furniture for most of the time, was little more than a wire cage that protected those within from the falling debris if there was a direct hit or nearby blast.





Point of explanation: Y5 Structures – Block E

Core Knowledge	Explanation			
frame	A frame is the supporting structure of a piece of furniture, a building, a vehicle etc. that gives it its shape.			
I-beam	An I-beam is a girder which has the shape of an I when viewed in section.			
struts	Struts are rods or bars forming part of a framework and designed to resist compression.			

Technical Vocabulary	Definition
brace	a device fitted to something to give support
mitre	a joint made between two pieces of wood or other material at an angle of 90°, such that the line of junction bisects this angle
gussets	brackets used to strengthen the joins of a structure

Link to Video: https://vimeo.com/657837457/8c92d49047

- Explanation and demonstration of taught content
- Lesson by lesson guidance
- Exemplification of techniques and outcomes



Point of delivery: Y5 Structures – Block E

Revisiting prior learning	Taught content	Point of practice	Point of reflection
 Triangles are used in construction to provide stability A truss is made up of a series of triangles joined together 	Explore ways in which framed structures are reinforced Understand and use technical vocabulary relating to the reinforcement of structures Experiment with methods of joining straws securely Evaluate outcomes	 Show pupils a picture of the Iron Bridge constructed by Abraham Darby III in 1779. Prompt pupils to describe the structure and shape of the bridge and to suggest ways in which the design ensures stability. Introduce the key question for this unit: How are frames strengthened, reinforced and made rigid? Define the terms reinforced, stability and rigid and discuss the technical vocabulary explained in the Knowledge Note. Share images of different devices and methods used in construction to reinforce joins and strengthen framed structures. Invite pupils to survey the classroom and, if possible, look around the school, to find examples of such methods in the school environment. Demonstrate some methods of joining straws such as: wrapping the flattened end of one straw around the other to form a gusset and securing with glue. inserting a pipe cleaner into both straws to create a flexible join. cutting a semicircle from card to act as a gusset plate upon which several straws can be glued. Provide opportunities for pupils to explore a range of ways to join their straws. Pupils can put their examples into their portfolios with evaluative notes and comments. 	Can identify ways in which framed structures have been reinforced and use technical vocabulary to describe these methods Can use modelling materials confidently to create examples of secure joins Can judge the success of their joins and give reasons why some methods are less effective than others
 2. Identify and recognise structural supports Understand and use technical vocabulary relating to structures Create strong joins for paper straws 	Use carpentry equipment appropriately and safely Saw lengths of wood to create a frame Recognise that triangles are the most suitable shape to create gussets and braces to reinforce joins in a frame Make a written record of the work completed using appropriate vocabulary	Recap and discuss the methods of reinforcing joins explored in the previous lesson. Which of the pupils' joins were most secure and why? Introduce carpentry equipment to pupils: hacksaw and bench block. Demonstrate how to use these safely to cut lengths of wood accurately. Provide opportunities for pupils to practise sawing lengths of wood. Pupils will require four lengths which they will use to construct a square or rectangular frame. Revisit the image of the Iron Bridge created by Abraham Darby III and prompt pupils to identify the shapes that have been used to create stability and strength in the structure. Can they see examples of braces and gussets? Through discussion, establish that triangles have been used, particularly at potentially vulnerable parts of the bridge. Demonstrate methods for joining sections of craft sticks and then how triangles of card can be used by pupils to create gussets to reinforce the joins of their wooden frame. Show pupils how larger, folded triangles can be used as a brace to support and strengthen joins where an upright length of wood has been added to the frame. Pupils use photos, drawings and annotations to provide a record of their work. They then complete Vocabulary Task 1.	Can use carpentry equipment appropriately, safely and with accuracy and control Can cut four pieces of wood to a specified length to form a frame Can identify the most suitable shapes used in construction for reinforcement and strength Can construct a frame using triangles acting as gussets and braces Can explain what they have done verbally and in writing using technical vocabulary



Point of delivery: Y5 Structures – Block E

Revisiting prior learning	Taught content	Point of practice	Point of reflection
3. Structural engineers work with architects to ensure structures withstand forces Triangles are the most suitable shape to create gussets to reinforce joins and provide stability in a structural frame	Apply knowledge of how to make a structure to fulfil a specific brief Use carpentry skills to construct a stable frame, incorporating structural joins for additional support and strength Identify the structural joins used and give reasons for choices Evaluate and modify the design and structure as needed	Refer pupils to the overarching question for this unit: How are frames strengthened, reinforced and made rigid? Through questioning and discussion, elicit pupils' recall and understanding of the methods of reinforcement explored in the previous lessons. Show pupils images of Anderson and Morrison shelters used in World War II and consider what was needed in these structures to ensure stability. Which of the shelters do pupils think would be more stable and why? Challenge pupils, using the skills and knowledge they have gained, to design and build a model of a shelter that will fit a family of four (use model figures for scale and proportion). Links could be made to refugee camps and displaced people and the need for sustainable, quick and easy-to-build shelters. Encourage pupils to draw out their design using annotations to indicate the range of structural joins that will be used to provide support and strength. Ensure pupils evaluate their designs and construction as they progress so that modifications can be made where necessary. Pupils use photos, drawings and annotated diagrams to record their work and evaluate outcomes. Pupils then complete Vocabulary Task 2.	Can apply prior learning to a different context Can demonstrate accurate carpentry skills Can identify the methods used to reinforce joins of a structure, using the correct technical vocabulary Can identify weaknesses and strengths of a structure and suggest modifications





Oracy and Vocabulary: Y5 Structures – Block E

Task 1: Sort these verbs according to their meaning.

bolster undermine	diminish	reinforce	impair	toughen	boost	fortify
to strength	en			to w	veaken	
Exploration:						
 Are there any other w If you cut the wood a 	ays of reinf t a 45° ang	orcing join: le, does thi	s that do s create	n't involve a more sto	triangl Ible join	es? ?
Task 2: Work with a partner to evaluate your shelter design and construction.						
Explain your design to a partne Were these plans successful?	r. How did y	ou plan to re	inforce joi	ns?		say say
How does your original design What changes or modifications	compare with did you mak	ı your compl e and why?	eted const	ruction?		say say
How successful have you been Write about your thoughts in y	n fulfilling th our portfolio.	e brief?				
If you did this task again, what	would you d	lo differently	and why:)		

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Vocabulary: Y5 Structures – Block E

OWN-it	Analyse 🔊	KNOW-it	Define 👤
Write the root of structural.		Explain what an I-beam is.	
Change this noun to an adjective.		Tick the correct definitions of the	e word <i>brace.</i>
mitre /		□ a device that holds things tog	ether
		a device that reduces stability a device that reinforces structu	ures
Tick the correct word class for the <i>reinforcement</i> .	e word	Write a definition of the word <i>ge</i> more than five words.	<i>ussets.</i> Use no
🗖 noun			
u verb adverb			
	- O		
LINK-it	Connect	USE-it Use	in context M
Investigate and write the meanin idiom.	g of this	Explain two uses of braces.	
We took a belt and braces of	approach.		
Write two words that can be gen	erated from	Explain what <i>gussets</i> , <i>struts and</i> common.	braces have in
Tick the synonyms of the word <i>st</i>	able.	Tick the sentence if the word <i>rein</i> been used correctly. Then, write	<i>ıforced</i> has your own
□ secure		sentences using this word.	<u>,</u>
anchored		The seat of the chair was reing decorative pattern.	forced with a



Knowledge Note: Y5 Structures – Block E

Year 5: Structures How are frames strengthened, reinforced and made rigid?

Core content:

Explore a range of ways that frames are reinforced to make them stable.

Identify joins and supports.

Create a model shelter based on what they have learnt.

Technical vocabulary:

Frame – the supporting structure of a piece of furniture, a building, a vehicle etc. that gives it its shape.



 $\ensuremath{\textbf{I-beam}}-a$ girder which has the shape of an $\ensuremath{\textbf{I}}$ when viewed in section.

Struts – rods or bars forming part of a framework and designed to resist compression.

Brace - a device that holds things together or holds and supports them in position.



Mitre — a joint made between two pieces of wood or other material at an angle of 90°, such that the line of junction bisects this angle.



Gussets — brackets used to strengthen joins of a structure.



Connections:

Abraham Darby III (1750 – 1789) English ironmaster and Quaker



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Look at the work of Abraham Exemplification: Y5 Structures – Block E

How are frames strengthened, reinforced and made rigid?

Darby III and discuss how the



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Exemplification: Y5 Structures – Block E

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