Year 3 Design and Technology: Structures – Block F
What makes a bridge strong?

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

Lesson 1	Lesson 2	Lesson 3
Identifying features of bridges Exploring ways to stabilise a simple structure	Introducing a design and make challenge Identifying ways to stabilise a structure	Application of skills Evaluation and adaptation

Sir John Wolfe Barry
(1836 – 1918)

Sir Horace Jones
(1819 – 1887)

Tower Bridge
(1894)

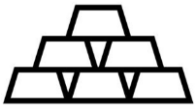
At the end of this block, pupils will …	
Know:	**Be able to:**
Bridges are structures that allow people and vehicles to cross over an open space Towers, piers and arches provide strength to a bridge	Design and build a beam bridge that can hold the weight of 100 pennies Identify and name parts of a bridge

In this block, pupils will investigate how the shape and features of a bridge can affect how strong it is.
They will also identify types of bridges and the structural changes that engineers and architects make to increase the stability of structures.

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:
Y3 Structures – Block F

Pupils will be able to:
- build structures using a range of different materials



Prior Learning

- make a structure in accordance with a set of criteria
- recognise that a cylindrical pillar is stronger than a rectangular one

Design or Technology History:

Sir Horace Jones (1819 – 1887)
Sir John Wolfe Barry (1836 – 1918)
Tower Bridge is a Grade I listed bascule and suspension bridge that crosses the River Thames in London. It was designed by English architect Sir Horace Jones and built between 1186 and 1894. The structure was engineered by Sir John Wolfe Barry, son of the famous architect Sir Charles Barry. The bridge is 240m in length and consists of two 265m bridge towers connected at the upper level by two horizontal walkways. It has a central pair of bascules that can open to allow shipping to pass through.

Links to Literature:

The Tower Bridge Cat by Tee Dobinson
13 Bridges Children Should Know by Brad Finger
Awesome Engineering: Bridges by Sally Spray
Listen to the Wind by Greg Mortenson

Materials:

Wooden cubes, 100 pennies in a sealable snack bag, craft sticks, images of bridges, cardboard from packaging, paper, masking tape, scissors, house bricks, split pins, yarn or string

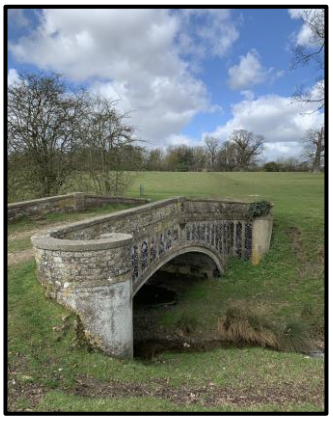
Health and Safety:

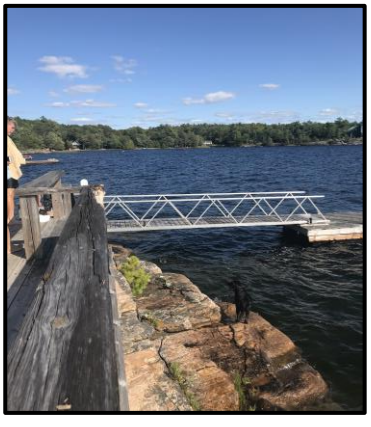
This block requires pupils to use: scissors and house bricks. Teachers should ensure that they follow their own school's risk assessments and policies for using the necessary materials and equipment. Pupils should be taught about how to use equipment and materials safely and responsibly as part of these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

Working as a Designer

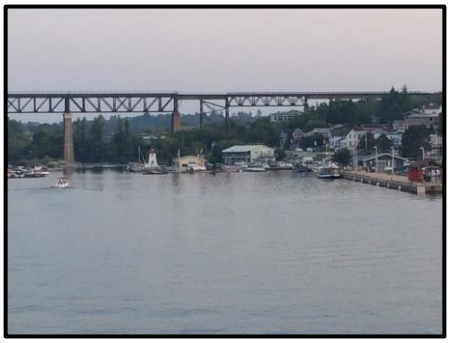
Design	Make	Evaluate	Apply
The art or process of deciding how something will look or work.	Create something by combining materials or putting parts together.	Form an opinion of the value or quality of something after careful thought.	Use something or make something work in a particular situation.

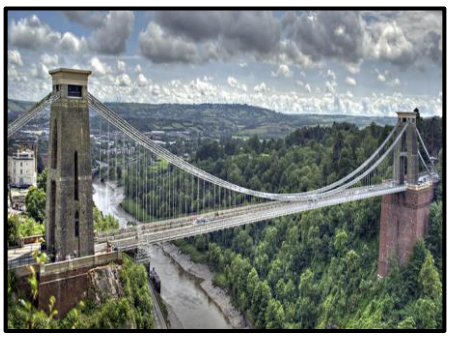
Supporting images: Y3 Structures – Block F





Supporting images: Y3 Structures – Block F





Point of explanation:
Y3 Structures – Block F

Core Knowledge	Explanation
gap	A gap is an empty space or opening in the middle of something or between two things.
deck	A bridge deck is the roadway, or the pedestrian walkway, surface of a bridge.
pier	A bridge pier is a type of structure that extends to the ground below or into the water. It is used to support the bridge and transfer the loads to the foundation.

Technical Vocabulary	Definition
suspension	a type of bridge in which the deck is hung below suspension cables on vertical suspenders
arch	a curved structure that supports the weight of something above it, such as a bridge or the upper part of a building
bascule (pronounced *bas-kyool*)	a movable bridge deck where the rising floor or section is counterbalanced by a weight

Link to Video: https://vimeo.com/662675996/11bb955b76

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

Point of delivery:
Y3 Structures – Block F

Revisiting prior learning	Taught content	Point of practice	Point of reflection
1. Build structures using a range of different materials Make a structure in accordance with a set of criteria	Label an image with the key features of a bridge Identify types of bridges Identify differences and similarities between images of a range of bridges Explain the purpose of a bridge and the importance of strength and stability Explore how using weight as a counterbalance can provide stability to a bridge structure	Introduce the key question for this unit: **What makes a bridge strong?** Share images of a range of different types of bridge and pose questions to pupils such as: What is the purpose of a bridge? Why does a bridge need to be strong? What do the bridges have in common? What differences do you notice? Share the Knowledge Note and key vocabulary and teach pupils about the different features of a bridge. Explain the different types of bridge, such as bascule and suspension, and challenge pupils to identify these features and types in the images provided. Pose questions such as: Why do so many of the bridges have arches? Is it only the suspension bridges that have tall towers? Pupils then add some images to their portfolio and annotate them. Challenge pupils to create a simple beam bridge using craft sticks and wooden cubes. How can they span a gap that is larger than the length of one craft stick? Prompt pupils as necessary to investigate ways of spanning the gap with two sticks and using wooden cubes as a counterbalance weight at each end. Can pupils span a wider gap, where three sticks are needed? What adjustments do they need to make to the weights added to each side to stabilise their bridge? Establish, through exploration and discussion, that both balance and weight affect the stability of a bridge structure. Challenge pupils to see how wide a gap they can span with craft sticks, connecting them with pegs. Can pupils make a platform of sticks to span the gap, without using pegs? Encourage pupils to use diagrams and notes to make a record of their investigations and findings.	Can identify the key features of a bridge and explain their purpose Can identify differences and similarities between bridges Can explain what a bascule and suspension bridge is Can identify features that are used to give a bridge strength and stability Can use specified materials to build a simple bridge structure, showing an understanding that using weights as a counterbalance gives the bridge added stability

Questions for assessment

How are the bridges different / similar?

Which parts of the bridge give it strength and stability?

Do all bridges have arches?

What happens if you don't add weight to either side of your bridge?

How can you span a gap that is larger than the length of two craft sticks?

Do you need to add more weight to either side of the bridge each time you extend the size of gap you are trying to span?

Point of delivery:
Y3 Structures – Block F

Revisiting prior learning	Taught content	Point of practice	Point of reflection
2. Weights can be used to support a bridge A pillar is used to give strength and stability to a structure A cylindrical pillar is stronger than a rectangular one	Explore ways of stabilising a beam bridge made from paper Create features such as arches and piers from paper Modify a design in light of test results Make decisions about which features are most effective at strengthening a bridge Evaluate outcomes	Refer pupils to the work they did in Year 2 to explore how paper could be made stronger. Remind them about what a pillar is and how these can be made from paper. Explain that a pier is similar to a pillar because it provides strength and stability to a bridge structure. Explain what a beam bridge is and challenge pupils to make a beam bridge using a sheet of paper spanning a gap between two bricks. Using a bag of one hundred pennies as a weight, pupils establish that one sheet of paper is not strong enough to bear this load. Pose the question: How can you adapt the bridge so that it will hold the weight of the pennies? Prompt pupils to consider adjustments they could make to increase strength and stability, such as placing an arch or series of piers beneath the deck of the bridge. What happens if they add towers (weights) to either side of the bridge? Challenge pupils to explore how they can make their paper bridge strong enough to hold the weight of one hundred pennies. Encourage pupils to design, build, test and modify their bridge, making a record of their results and design changes. Pupils then complete Vocabulary Task 1.	Can identify ways in which a paper bridge can be supported, using arches, piers or counter-weights Can suggests ways in which their design could be improved, and their structure strengthened Can identify strengths and weaknesses in their completed bridge and suggest which features have affected the strength of their bridge

Questions for assessment

Does the shape of a pier affect the strength of the bridge?

Is one pier less effective than two?

Does it matter what size of arch is used?

What changes could you make to increase the weight the bridge will hold?

Does adding towers or weights at each side of the bridge increase its stability? **How** do you know?

Point of delivery:
Y3 Structures – Block F

Revisiting prior learning	Taught content	Point of practice	Point of reflection
3. Engineers and architects use their understanding of materials to ensure a structure has stability A load is the amount of weight a structure can carry Features such as arches and piers add stability to a bridge structure	Design and construct a bridge to hold a specified weight and span a specific gap Make decisions about which features to include and explain reasoning Construct features from cardboard and attach bridge parts securely to ensure stability Adjust a design to improve the stability and strength of a bridge structure Evaluate outcomes and make suggestions for improvements	Remind pupils of the key question for this unit: **What makes a bridge strong?** Through questioning and discussion, identify the key features that give a bridge support and stability. Invite pupils to share what they have learnt from the previous two lessons and how they could apply this knowledge to make a bridge from cardboard. Encourage pupils to consider which features their bridge will have and why. Pose questions such as: Will your bridge have piers or arches or both? Will the bridge have towers at each side? How could you construct these from cardboard? How will the deck be attached to the sides of the bridge? Pupils make annotated design drawings in their portfolios with an explanation of the materials they will use and the reasons for their choice of features. Prompt pupils to test their completed bridge to see how much weight it will hold and encourage them to identify ways in which the stability and strength could be increased so that the bridge could hold a heavier weight or span a wider gap. Pupils make the necessary modifications, re-build and re-test their structures, making a record (using photographs or diagrams) of these changes in their portfolios. Pupils could be challenged further to design and construct a bridge that has a movable deck. Explain that the deck could be made to turn or lift up. How could pupils do this with the materials provided? Pupils evaluate their bridges and record their reflections in their portfolios, using Vocabulary Task 2 as a guide.	Can apply prior learning to solve a specific design problem Can make reasonable decisions about which features to include and give reasons for choices Can use construction materials to make three dimensional shapes with secure joins Can generate ideas about how to modify a design to increase the strength and stability of a free-standing structure Can identify strengths and weaknesses in their completed bridge and make suggestions for improvements

Questions for assessment

What features does your bridge have? **How** did you make them?

How could you strengthen your bridge further?

If your bridge is unstable, **how** could you solve this problem?

What would you have to do differently if you were making the bridge from paper instead of cardboard?

What adjustments could you make to enable your bridge to span a wider gap?

Would you do anything differently next time?

Oracy and Vocabulary:
Y3 Structures – Block F

Task 1: Order these words from weakest to strongest.

stable
unyielding
flimsy
reinforced
solid
feeble

Exploration:

say say

Decide whether these statements are True or False.

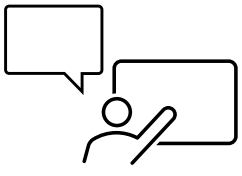
1. A bridge with piers is always going to be stronger than a bridge with arches.
2. The size of the arch does not affect the stability of the bridge.
3. The shape and positions of the piers affect the stability of the bridge.

Task 2:
Evaluate your completed bridge. Talk to a partner, giving answers to these questions.

say say

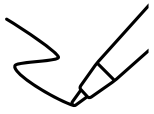
Explain to a partner …

- why you designed your bridge in the way that you did.
- how you decided which features to include.
- the changes you made to your structure and why.



Write some sentences in your portfolio to answer these questions.

1. Which parts of your bridge are you pleased with?
2. How could you improve the stability and strength of your bridge?
3. How could / did you create a movable deck?
4. What would you do differently next time? Why?



Vocabulary: Y3 Structures – Block F

OWN-it — Analyse

Write the root word.

stabilise - _____

Write the present tense form of this verb.

suspended

Change this adjective to a noun.

arched - _____

KNOW-it — Define

Write the word that matches this definition.

A curved structure that supports the weight of something.

Complete this sentence.

Piers are used _____

_____ .

Draw lines to join the word to its definition.

gap	a walkway
deck	an empty space
pier	a type of pillar

LINK-it — Connect

Circle the word that is the odd one out.

curved arched angled

Write a synonym of the word *suspend.*

Explain what this idiom means.

all hands on deck

USE-it — Use in context

Use the word *suspension* in a sentence.

Tick the sentence if the word *pier* has been used correctly.

The girl had to *pier* through the window to see if anyone was there.

Write a sentence using the words *bascule, movable* and *bridge.*

Knowledge Note:
Y3 Structures – Block F

Year 3: Structures

What makes a bridge strong?

Core content:

Investigate how the shape and features of a bridge can affect how strong it is.
Identify types of bridges and the structural changes that engineers and architects make to increase the stability of structures.

Technical vocabulary:

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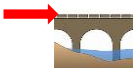

Pier – a type of structure that extends to the ground below or into the water. It is used to support the bridge and transfer the loads to the foundation.

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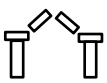
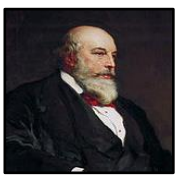


Connections:



Sir Horace Jones
(1819 – 1887)

Sir John Wolfe Barry
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Tower Bridge
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Year 3: Structures

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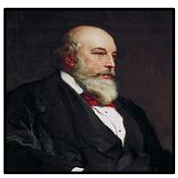

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Exemplification: Y3 Structures – Block F
What makes a bridge strong?

Use craft sticks to bridge the gap between two books

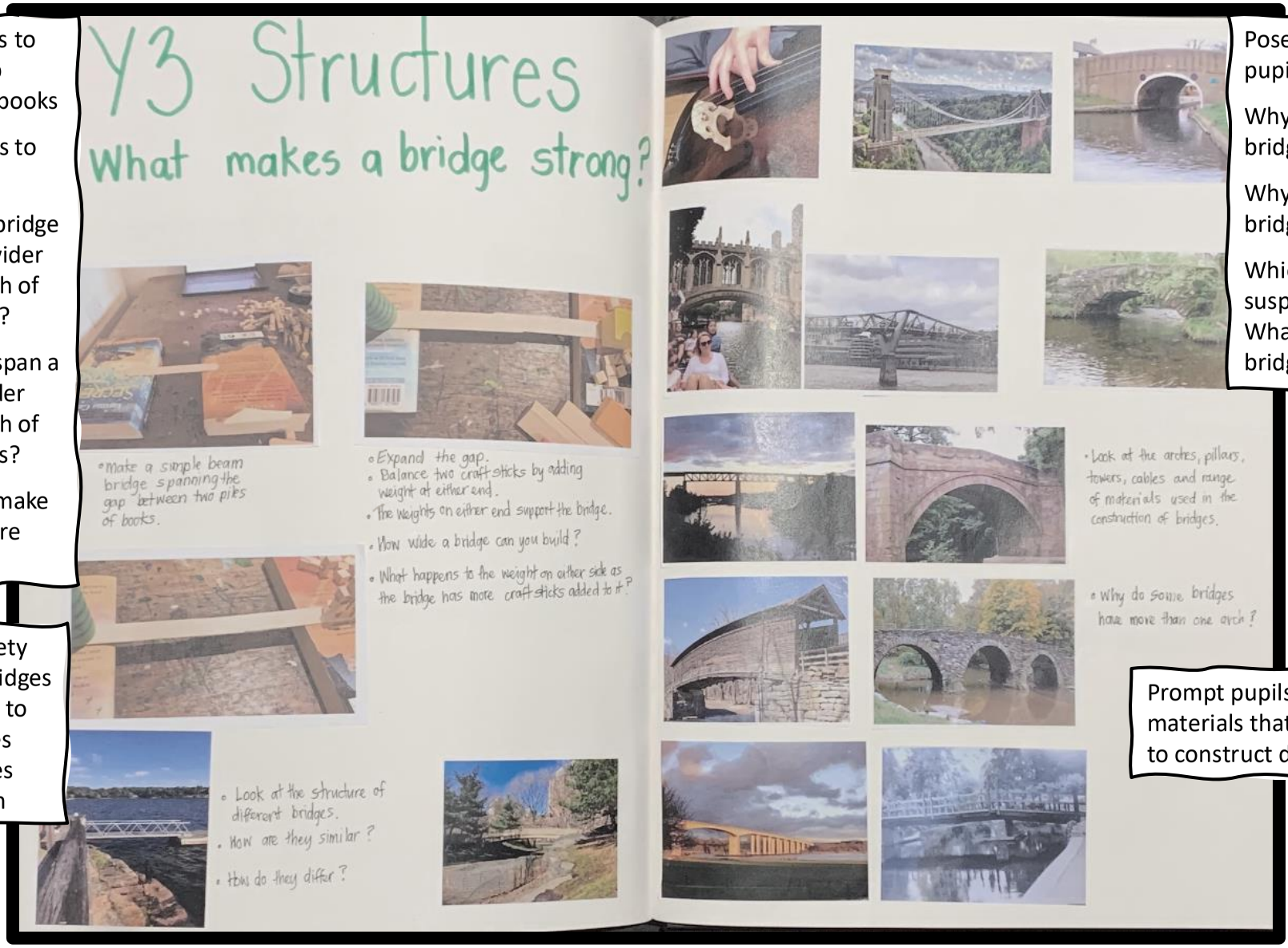
Pose questions to pupils:

How can you bridge a gap that is wider than the length of one craft stick?

How can you span a gap that is wider than the length of two craft sticks?

How can you make the bridge more stable?

Present a variety of different bridges and ask pupils to find similarities and differences between them



Pose questions to pupils:

Why do some bridges have arches?

Why do some bridges have piers?

Which bridges have suspender cables? What are these bridges called?

Prompt pupils to identify materials that have been used to construct different bridges

Exemplification: Y3 Structures – Block F
What makes a bridge strong?

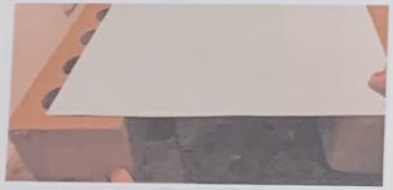
Challenge pupils to construct a beam bridge using only craft sticks and clothes pegs

Can pupils weave the sticks together to form a bridge platform?

- make a beam bridge connecting the sticks with clothes pegs.

- Connect craft sticks to form a platform by weaving them together.

- Use a piece of cardstock as the bridge platform.

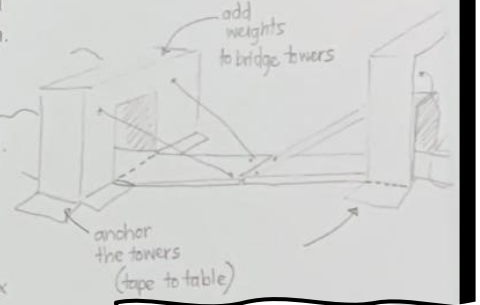


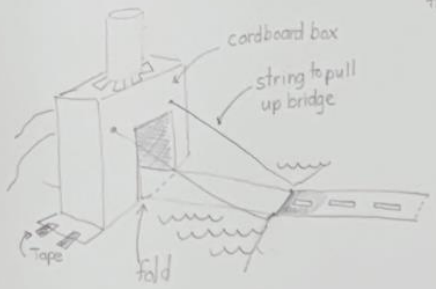
- Test by adding a weight of 100 pennies.

- Support by placing an arch in the gap.
- Lay the platform on top and test with weights.

- Next, use pillars as supports.
- Test and evaluate.

- Design and build a bridge that will open to allow traffic to pass through.
- Consider placing towers on either side to help balance and support the bridge.
- Use cardboard or recycled materials.





Add piers to support the bridge

Ask pupils:

Does the shape, position and number of piers affect the amount of weight the bridge can support?

Challenge pupils to design a bridge that will open or turn to allow traffic to pass through

Pupils produce annotated designs of their bridges identifying key features and explaining how the bridge will work

Ask pupils to make a bridge from card that can bear the weight of 100 pennies

Prompt pupils to add an arch underneath and test again