When you read you start with a,b,c. When you sing you start with do, re, mi. When you build you start with tension and compression

STRUCTURES UNIT

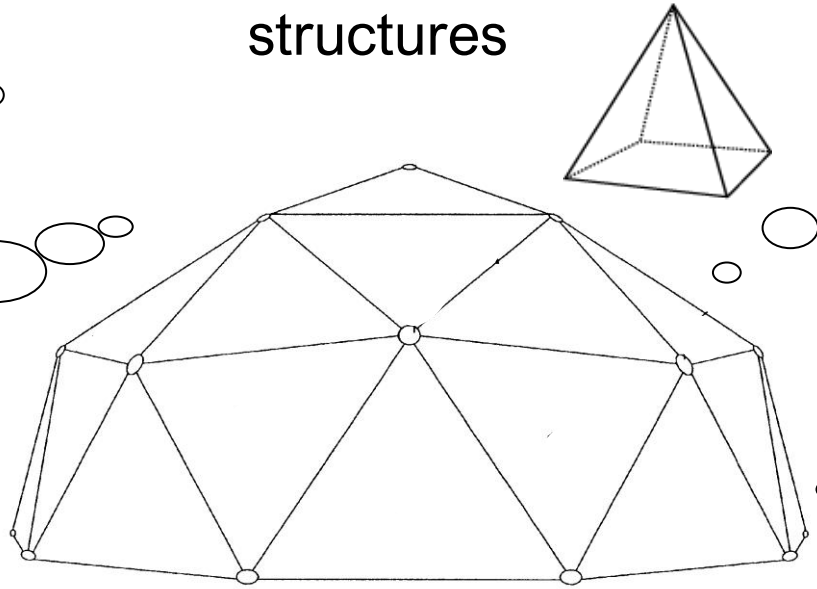
This is a unit that can be done by year 10,11 or 6th form from home over 6 weeks at your own pace if stuck all answers should be on the internet.
If you can watch this, You Tube Video First.
https://www.bing.com/videos/search?q=triangle+structures+kids&docid=608041466050708897&mid=1C8D1C332C64EB9871631C8D1C332C64EB987163&view=detail&FORM=VIRE

DESIGN TECHNOLOGY STRUCTURES

From what am I going to make my structure?

We will be researching and investigating different types of structures

How are the Eden Project domes made?



Which structural shape can carry the most load without breaking?

What is the tallest building in the world?

How can I make my bridge span 80cm using only paper?

We will also be learning how to make structures such as towers, domes, bridges and observation wheels using geometric shapes.

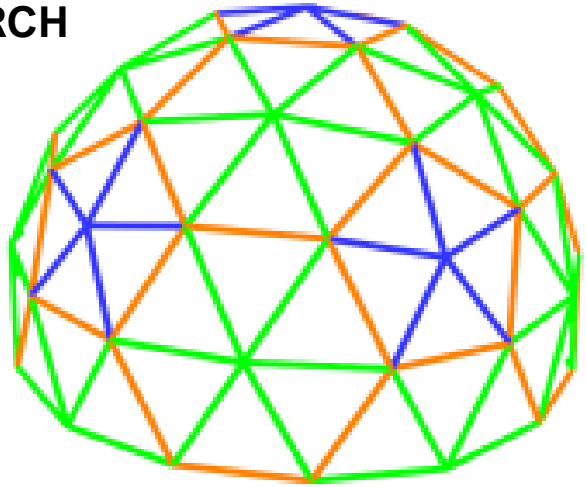
How was the Millennium Wheel and Dome designed?

STRUCTURES

MY BOOKLET

DESIGN TECHNOLOGY STRUCTURES

INDEX



Thanks to

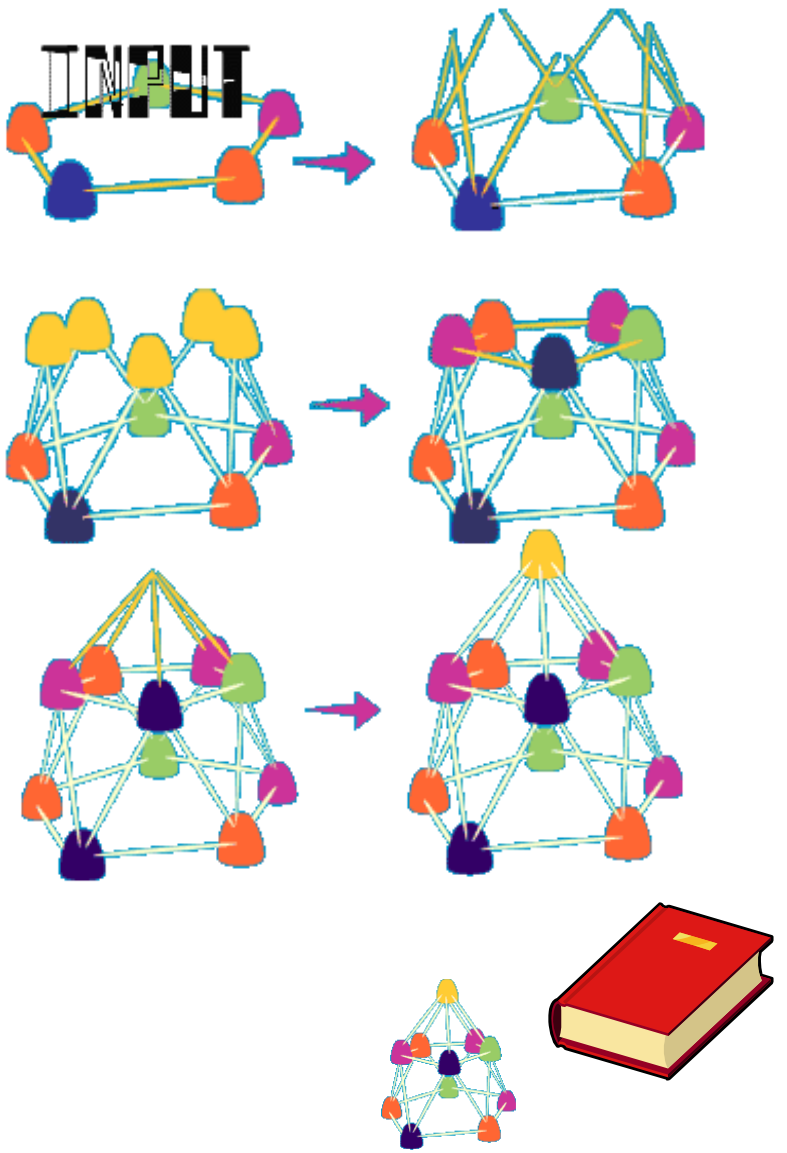
DT STRUCTURES 1 - ACTIVITY 1 -Investigating gumdrop structrures date.....

How many books do you think gumdrop domes can support?

1. In your structure groups, use five gumdrops to connect five toothpicks in a ring. This is your base. (**a**)
2. Use two toothpicks and one gumdrop to make a triangle on one side of the base. Repeat this all around the base until you have five triangles (**b**)
3. Use toothpicks to connect the gumdrops at the tops of the triangles (**c**)
4. Push one toothpick into each of the top gumdrops. (**d**)
5. Use one last gumdrop to connect these toothpicks at the top (**e**)
6. **How many domes do you think you will need to hold up a book?**
7. Make a prediction, then build as many domes as you think you may need.
8. Now it's time to test out the strength of your domes. Arrange your domes, and carefully place a book on top. If your domes can support one book, then keep going.
9. **How many books can your domes support?**
10. **Can you build your domes any taller?**

This is what I learned ……..…….

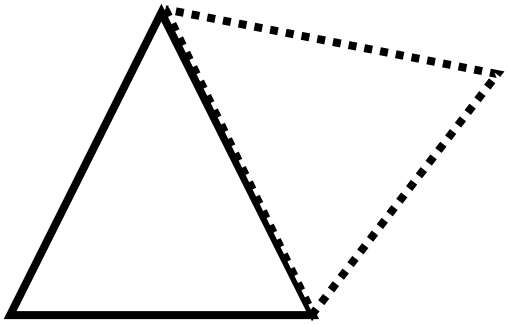
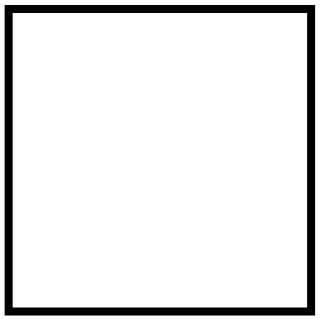
……..……



http://pbskids.org/zoom/activities/sci/gumdropdome.html

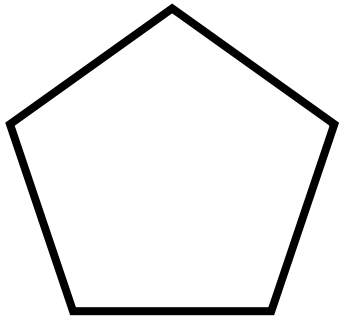
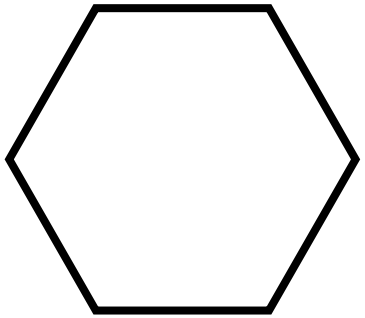
DT STUCTURES 2 - Investigating 2D Shapes - 1 date.....

All structures are made up of 2D shapes. Cut out and see how the shapes fit (tessellate) together

triangles	squares
	
Is this shape strong?	Is this shape strong? .....

DT STUCTURES 1 - Investigating 2D Shapes - 2 date.....

All structures are made up of 2D shapes. Cut out and see how the shapes fit (tessellate) together

pentagons	hexagons
	
Is this shape strong?	Is this shape strong? .....

Which shapes tessellate best……..

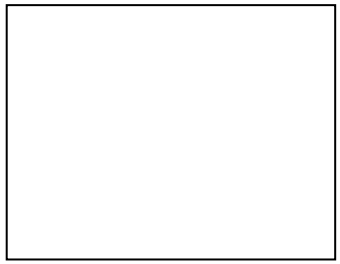
DT STUCTURES 2 - ACTIVITY 2 - Making beams from paper date.....

We are going to be making some beams to build some 2 and 3D structures to test their strength

You will need

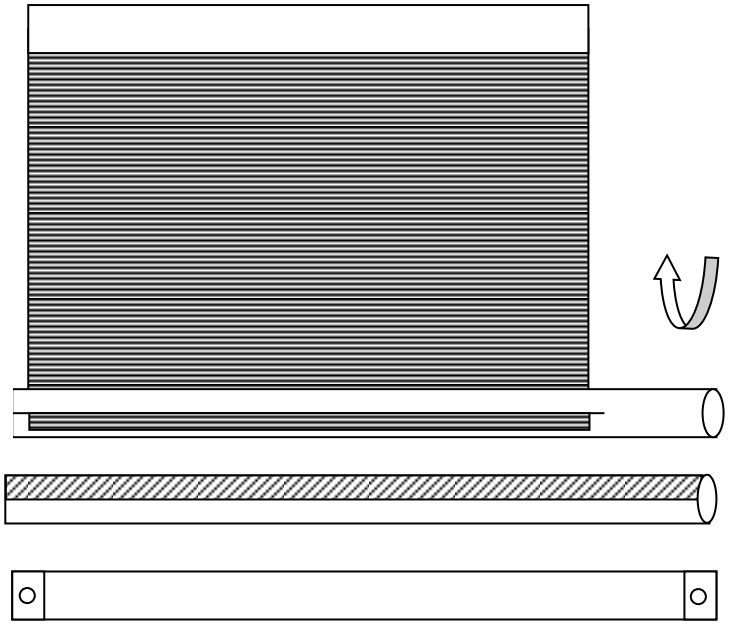
- A4 and A3 paper
- Masking tape
- Tube rolling system
- Nuts and bolts

1. Lay piece of paper on the desk (landscape)



2. Tear off a strip of masking tape and stick it right across top of your paper, sticky side down

3.Turn the paper over and thread the end (without the masking tape through the wooden split dowel



4. Roll up until you reach the masking tape. This will seal the paper strip

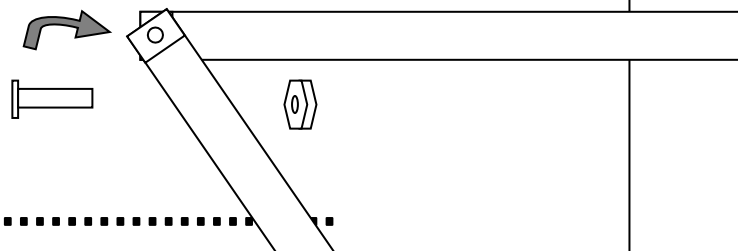
5. Flatten both ends (in the same plane) and punch a hole through.

6. This forms the basic beams from which you can make up different 2D shapes.
Use the nuts and bolts to attach them.

7. Make up each of the 4 shapes and test how strong they are.

Golden Rules for construction

- ***Only use good, undamaged tubes, rolled tightly***
- ***Make sure all holes are punched accurately***
- ***Only connect tubes at their ends, never in the middle!***
- ***Only use one nut on any one bolt!***
- ***Don't tighten the nuts until your structure is complete!***



Which 2D shape is the strongest?.....

DT STRUCTURES 3 - Investigating Towers

date.....

Draw one of the towers

When do you think this tower was first built?.....

How has the tower been constructed? Draw the different sections

List the materials used to construct this tower

……..……

……

……

……

……

Why do you think towers are often used in modern architecture?

……
……..

……
……..

……
……..

DT STUCTURES 3 - ACTIVITY 3 - The Communications Tower date.....

INTRODUCTION

Your team of engineers are involved in a project to build a large oil refinery in a West African country. Torrential rain has caused flash floods and mudslides resulting in many deaths. All domestic services such as water and electricity have been totally disrupted and the lives of many people threatened..
Your team has been asked to design and construct a communications tower to carry a satellite dish. This will enable the emergency services to be directed more efficiently and save many lives. The tower must be at least 10m in height.
The only materials for the structures are scaffold tubes, each 3m long and connection fittings.

YOUR CHALLENGE

Your challenge is to design and build a model of the tower. This will be used to evaluate the design and help builders to complete the structure.
Your model must be completed in**1 hour**

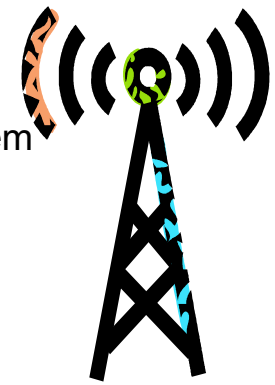
THE MODEL

Your model should be built to 1/10scale using the materials below:
Your model should be:

- **Stable** – it must be able to support itself without toppling
- **Strong** – it must be able to support a 2kg weight hanging from its highest point
- **Tall** – your tower must be at least 1m tall
- **Cost effective** – it must use the least amount of materials

MATERIALS

- A4 and A3 paper
- Masking tape
- Tube rolling system
- Nuts and bolts
- Cord



TOP TIPS

- Make your structure out of connected **triangles**.
- Start from the bottom and work up
- Use only A3 struts.

DT STUCTURES 4 - The Communications Tower - My Evaluation date.....

My tower model was:

Stable –

Strong –
supported a 2kg weight

Tall –
1m tall

Cost effective –
I used ……..beam

I think my tower is ….....……

…….……...

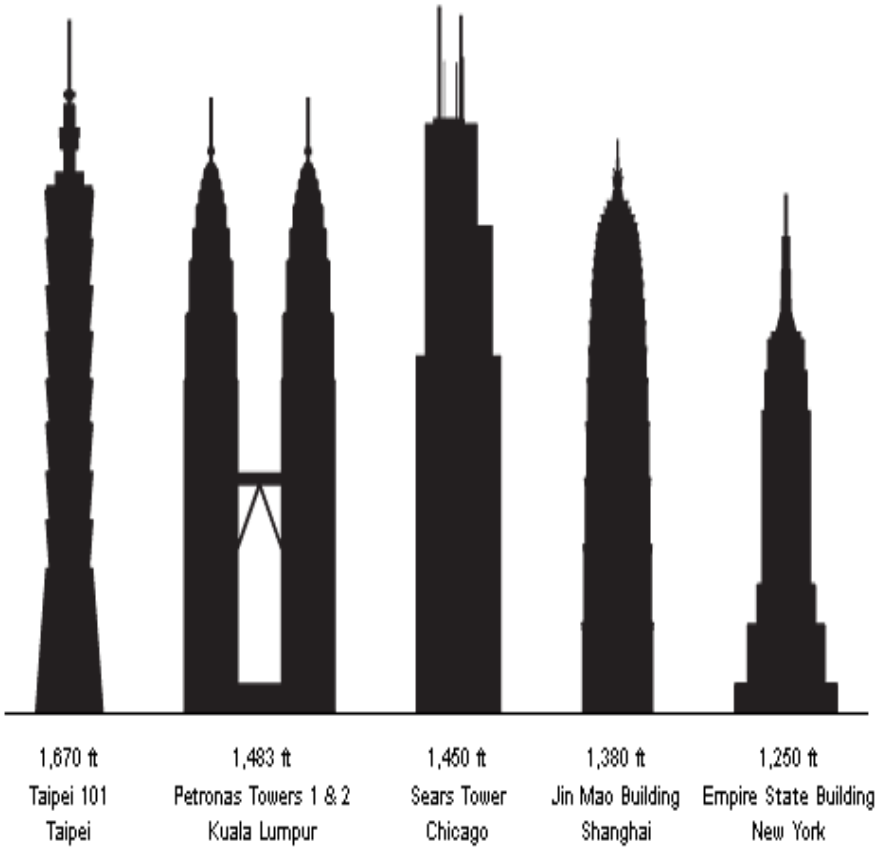
If I was to make it again I would ……..

……

……
……...

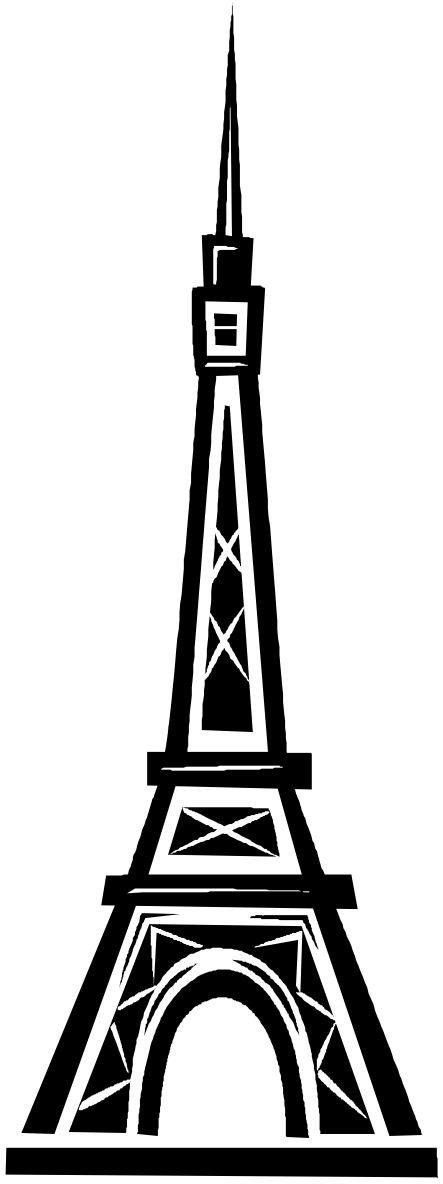
My tower

DT STUCTURES - FUN FACTS - 1 Top 10 tallest buildings



RANK	BUILDING, CITY	YEAR BUILT	STORIES HIGH	HEIGHT m
1.	Taipei 101, Taipei, Taiwan	2004	101	508
2.	Petronas Tower 1, Kuala Lumpur, Malaysia	1998	88	452
3.	Petronas Tower 2, Kuala Lumpur, Malaysia	1998	88	452
4.	Sears Tower, Chicago	1974	110	442
5.	Jin Mao Building, Shanghai	1999	88	421
6.	Two International Finance Centre, Hong Kong	2003	88	415
7.	CITIC Plaza, Guangzhou, China	1996	80	391
8.	Shun Hing Square, Shenzhen, China	1996	69	384
9.	Empire State Building, New York	1931	102	381
10.	Central Plaza, Hong Kong	1992	78	374
	OUR SCHOOL	1977	1	4

DT STUCTURES - FUN FACTS 2 - Top 10 tallest towers



TOWER, CITY	YEAR BUILT	Height (m)
Canadian National (CN) Tower, Toronto	1975	553
Ostankino Tower, Moscow	1967	537
Oriental Pearl Tower, Shanghai	1995	468
Milad Tower, Tehran	2005	435
Menara Kuala Lumpur, Kuala Lumpur, Malaysia	1996	421
Tianjin TV Tower, Tianjin, China	1991	415
Central Radio & TV Tower, Beijing	1992	405
Kiev TV Tower, Kiev, Ukraine	1973	385
Tashkent Tower, Tashkent, Uzbekistan	1985	375
Liberation Tower, Kuwait City	1996	372

DT STRUCTURES 3 - Investigating domes

date.....

Draw one of the buildings that has a dome

When do you think this dome was built?.....

How has the dome been constructed?
Draw the different sections

List the materials used to construct this dome

……..

……..

……..

……..

Why do you think domes are often used in religious buildings?

……..

……..

……..

DT STUCTURES 4 - ACTIVITY 4 - The New Eden Biosphere Vistor Centre date.....

Introduction

Following the great success of the Eden project in Cornwall, your company*, Eden Structural Designs*, has asked you, the structural design team, to produce and build a model of a design for a new visitor centre to be sited in Gloucestershire.
The centre will consist of a single dome, 10m high which will be linked with other domes in the future.

It will be a large building to house facilities such as displays, activities, exhibitions, space for conferences and lecture theatres and perhaps a smaller building acting as an entrance foyer and shop etc. The centre must be of elegant, modern design allowing a very light and spacious feel to the interior yet with an exterior appearance that will be attractive in a rural setting.

YOUR CHALLENGE

Your challenge is to design and build a model of your visitor centre
Your model must be completed in**1 hour**

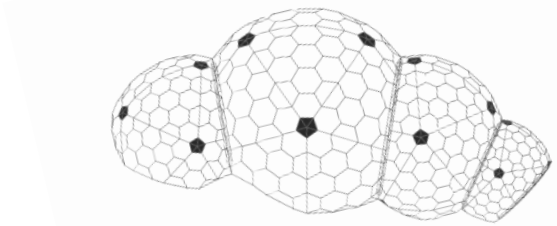
THE MODEL

Your model should be built to 1/10scale using the materials below:
Your model should be:

- **Stable** – it must be able to support itself without toppling
- **Strong** – it must be able to support a 2kg weight hanging from its highest point
- **Tall** – your dome must be at least 1m tall at the tallest point
- **Size –** your model should be able to hold 2 people
- **Design** – should be as stylish as possible

MATERIALS

- A4 and A3 paper
- Masking tape
- Tube rolling system
- Nuts and bolts
- Cord



TOP TIPS

Make your structure out of connected **triangles**.

It's best to start with the longer (A3) tubes and then change to the shorter (A4) tubes, though you may need to mix them in some places.

DT STUCTURES 4 - ACTIVITY 4 - The New Eden Biosphere Visitor Centre - My Evaluation date.....

My biosphere model was:

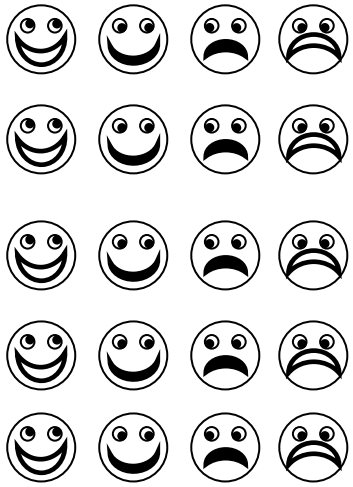
Stable –

Strong –
supported a 2kg weight

Tall – 1m tall

Size –
Holds two people

Design



I think my dome is …....……

……..……...

If I was to make it again I would ……..

……

……

My biosphere

DT STUCTURES - FUN FACTS 3 - World's largest domes in history date.....

NAME	HELD RECORD	DIAM. (M)	COMMENT
1.Treasury of Atreus, Mycenae, Greece	1250 BC – 1st century BC	14.5	Corbel dome
2. Temple of Mercury, Baiae, Italy	1st century BC – 128 AD	21.5	Concrete dome built by the Roman Empire
3. Pantheon, Rome, Italy	128 - 1881	43.4	Largest unreinforced solid concrete dome in the world built by the Roman Empire
4. Devonshire and Royal Hospital, Buxton, UK	1881 - 1902	46.9	Converted horse stables Slate covered frame.
5. West Baden Spring Hotel, Indiana, USA	1902 - 1913	61.0	Steel and glass dome.
6. Centennial Hall, Breslau, Poland	1913 - 1930	65.0	Reinforced concrete dome
7. Leipzig Market Hall, Germany	1930 - 1944	65.8	Reinforced concrete dome
8. V-2 Bunker, La Coupole, Wizernes, France	1944 - 1965	71.0	Reinforced concrete dome 5m thick built by Nazi Germany
9. Reliant Astrodome, Houston, Texas, USA	1965 - 1992	216.4	First domed sports stadium in the world
10. Georgia Dome, Atlanta, Georgia, USA	1992 – present day	256.0	Cable supported dome

DT STRUCTURES 5 - Investigating bridges date.....

Draw one of the bridges

When do you think this bridge was built?

How has the bridge been constructed?
Draw the different sections

List the materials used to construct this bridge

……..……

……..

……..

……..

……..

Over what gap would this bridge be best used ie. river, gorge, sea, motorway etc?

……..

……..

……..

DT STUCTURES 5 - ACTIVITY 5 - The Bridge of the Future date.....

INTRODUCTION

As the design team of a civil engineering company, you have been asked to design and make a model of a new lightweight footbridge to cross a small local river. The main load carrying structure of the bridge will be made from steel tubes connected together. At the point where the crossing is to be built, the river is 8 **m** wide and the banks on either side are **2 m** above the maximum river height.

The deck of the bridge across which people will walk must be at least **2 m wide** and provide headroom of at least **3 m at the centre** of the bridge for boats to navigate the river

YOUR CHALLENGE

Design and build a model of the new footbridge using the materials provided. It must be as light in weight as possible but must carry a load of at least 2.5kg at the centre of the bridge,
Your model must be completed in1 hour

THE MODEL

Your model should be built to 1/10scale using the materials below:
Your model should be:

- **Stable** – it must be able to support itself without toppling
- **Strong** – it must be able to support a 2.5kg weight hanging from its highest point
- **Span** – your bridge must have a span of 80cm
- **Weight –** it must be as lightweight as **possible**
- **Width –** your bridge must be **2**0cm wide

MATERIALS

- A4 and A3 paper
- Masking tape
- Tube rolling system
- Nuts and bolts

TOP TIPS

Make your structure out of Square based pyramids.

The pyramids should be made from the longer (A3) tubes .

Use the shorter (A4) tubes, when joining the pyramids.

DT STUCTURES 5 - The Bridge of the Future - My Evaluation date.....

My biosphere model was:

- **Stable** – 
- **Strong** – support a 2.5kg weight 
- **Span** – 80cm 
- **Weight** I used ……..beams 
- **Width -** 20cm wide 

I think my bridge ….....……

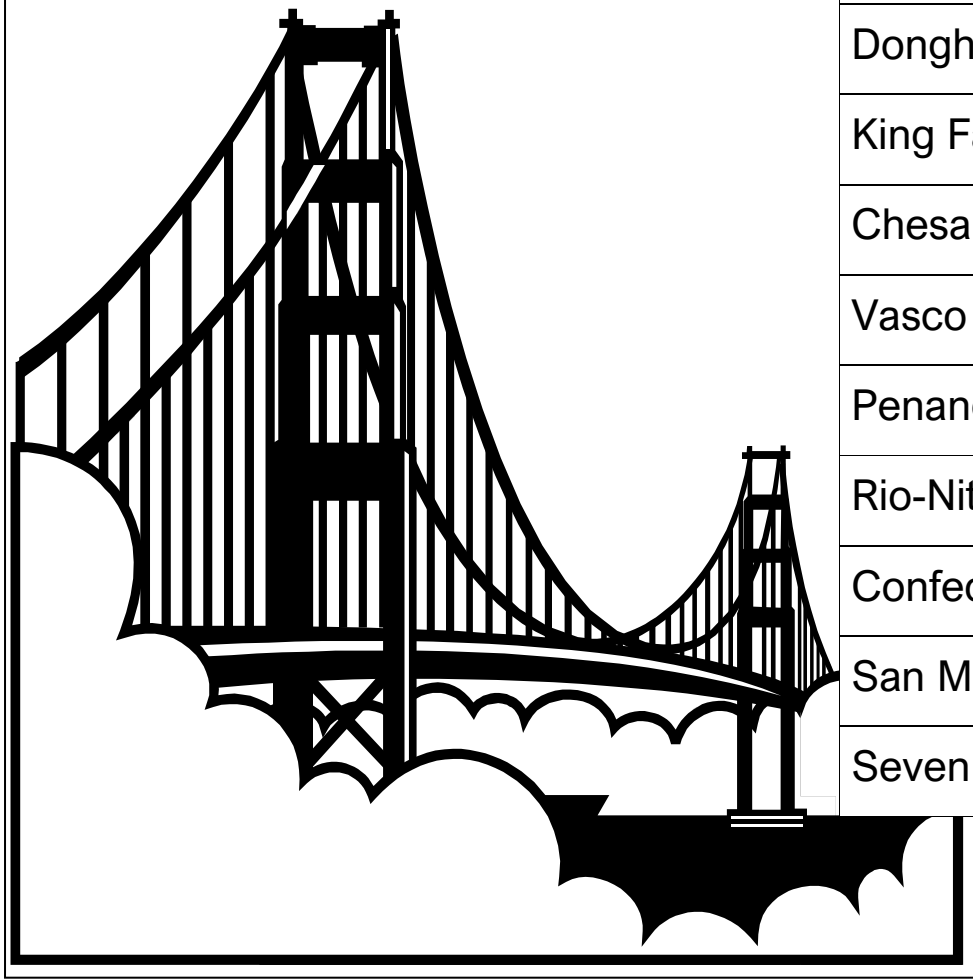
……..……...

If I was to make it again I would ……..

……

My bridge

DT STUCTURES - FUN FACTS 4 - top 10 longest bridges date.....



BRIDGE, COUNTRY	YEAR	LENGTH (Km)
Lake Pontchartrain Causeway	1969	38.422
Donghai Bridge, China	2005	32.500
King Fahd Causeway, Saudi Arabia	1986	26.000
Chesapeake Bay Bridge, USA	1964	24.140
Vasco da Gama Bridge, Portugal	1998	17.185
Penang Bridge, Malaysia	1985	13.500
Rio-Niteroi Bridge, Brazil	1974	13.290
Confederation Bridge, Canada	1997	12.900
San Mateo-Hayward Bridge, USA	1967	11.265
Seven Mile Bridge, USA	1982	10.887

DT INVESTIGATING STRUCTURES 6 - Observation Wheels date.....

Draw one of the observation wheels

When was it built?.....

List the materials used to construct it

……..……

……

……

What other features does it have?

……..……

……..

Why do people use these wheels?

……

……

……

DT STUCTURES 6 - ACTIVITY 6 - The Millennium Wheel

date.....

INTRODUCTION

The BA London Eye is a massive “viewing wheel” built to mark the year 2000 and gives passengers a panoramic view for 26 miles across the whole of London.

The wheel is a massive 135m high, weighs 1,600 tonnes and takes 30 minutes to go round. It never stops but passengers can get on and off because it goes so slowly.

Heavyweight Champion - Each of the 32 capsules weighs 10 tonnes. To put that figure into perspective, it's the same weight as 1,052,631 pound coins!

Flying High - The London Eye carries 3.5 million customers every year. You would need 6,680 fully booked British Airways Boeing 747-400 jumbo jets to move that number of fliers!

YOUR CHALLENGE

To make a model of the Millennium wheel made from paper (instead of steel) but connected in the same pattern as the real structure. Your model must be completed in1 hour

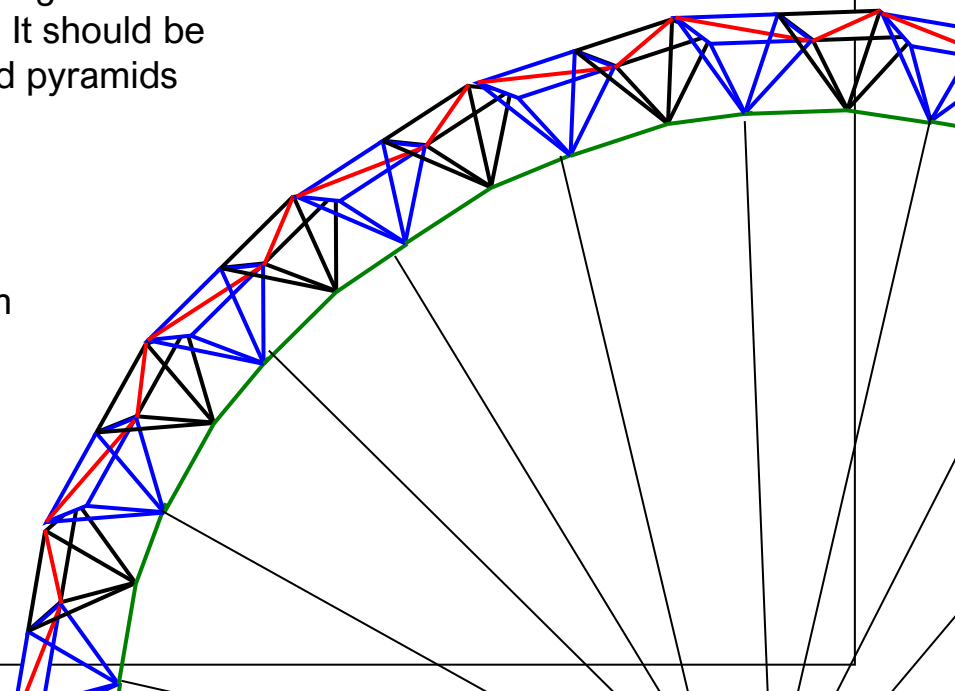
THE MODEL

The model of the Millennium Wheel is built by connecting sections made by different teams. It should be made up of square-based pyramids

MATERIALS

- A4 and A3 paper
- Masking tape
- Tube rolling system
- Nuts and bolts

Up up and away
The height of the London Eye is 135m (equivalent to 64 red telephone boxes piled on top of each other) making it the fourth tallest structure in London after the BT Tower, Tower 42 and One Canada Square in Canary Wharf.

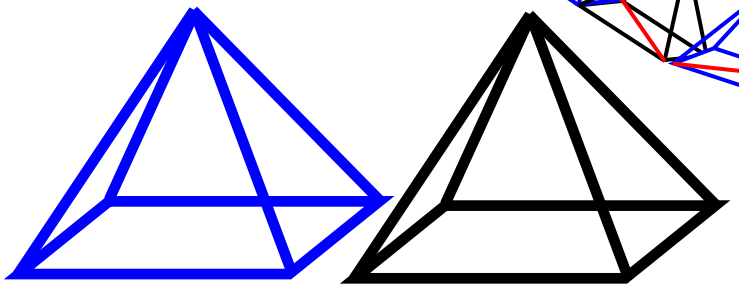


DT STUCTURES 6 - ACTIVITY 6- The Millennium Wheel

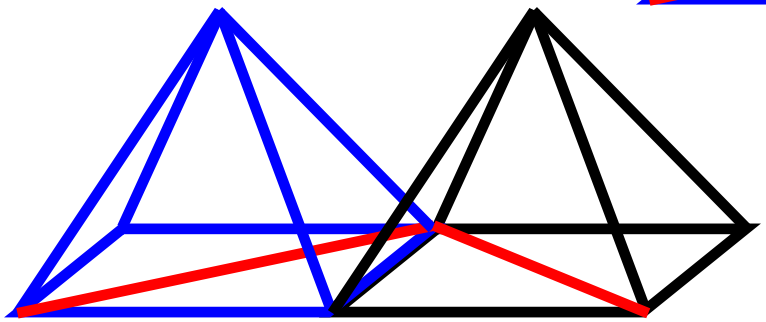
How To make the Millennium Wheel

To make the Millennium Wheel

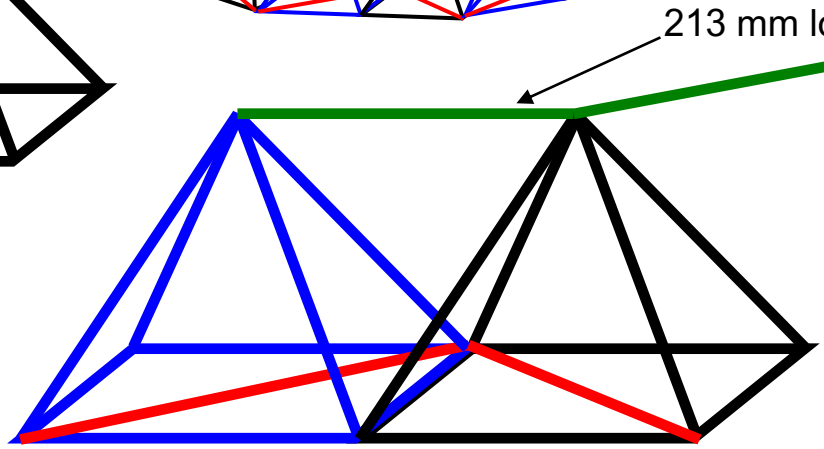
1. Make 2 square-based pyramids using A4 tubes
2. Make sure all the bolts face away from you.
3. Strengthen the bases by adding cross beams (404mm in length – which is a cut down A3 strut) so that they form a zig zag
4. Join them together at the base (you will lose one of the bottom struts when you join them)



Use A 4 paper



5. Join them together at the top using short struts (213mm long – a cut down A4 strut)



6. This makes one of the sections.

You will need 8 of these to make this model to make the Millennium Wheel

DT STUCTURES 6 - The Millennium Wheel - My Evaluation date.....

I think our Millennium Wheel is

…….....……

……..……

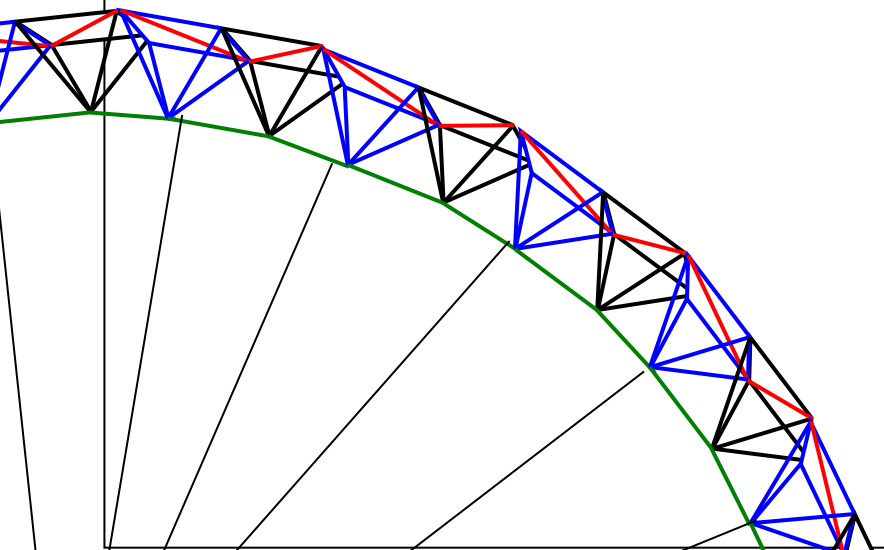
If I was to make it again I would

……..……

……

……

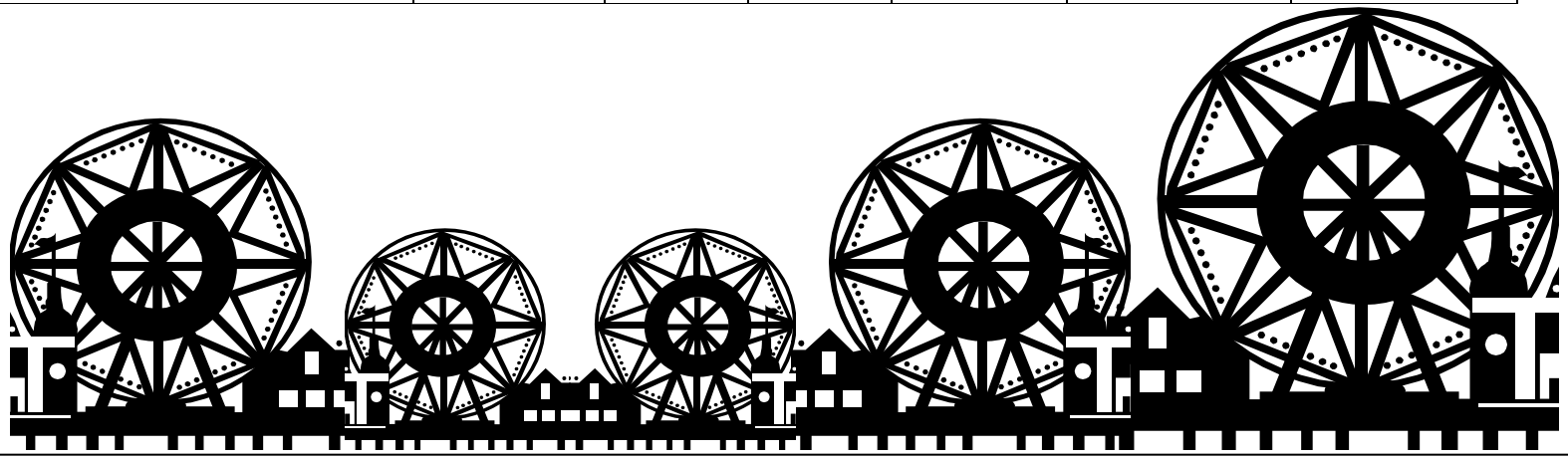
404mm long



Our Millennium Wheel

DT STUCTURES - FUN FACTS 5 - Top ten observation wheels

NAME	BUILT	HEIGHT (m)	DIAM. (m)	ROT. SPEED (mins)	CAPSULES/ PASSENGERS	PASSENGERS/ HOUR
1.The Great Beijing Wheel, China	2009	208	193	20	48 X 40	5760
2. The Singapore Flyer, Singapore	2008	165	150	37	28 x 30	1362
3. Star of Nanchang, China	2006	160		30	60 x 8	960
4. The London Eye, United Kingdom	1999	135		30	32 x 25	1600
5. Changsha Ferris Wheel, China	2004	120	99			
6. Southern Star Observation Wheel, Melbourne, Australia	2008	120		30	21 x 20	840
7. Zhegnzhou Ferris Wheel, China	2003	120				
8. Skydream Fukuoka, Japan	2002	120	112			
9. Diamond & Flower Ferris, Tokyo, Japan	2001	117	111	17	68 x 6	1440
10. Palette Town Ferris Wheel, Tokyo, Japan	1999	116	100	16		



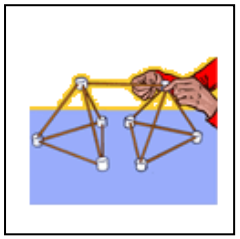
DT STRUCTURES 7 - ACTIVITY 7 -Spaghetti Bridge

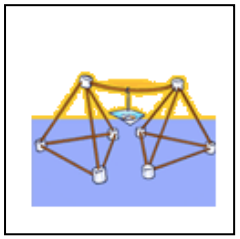
Objective

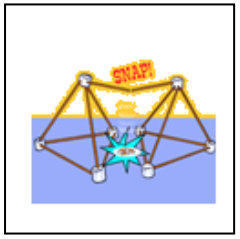
We are going to investigate the difference between the strength of bridges made from flat and round building materials.

What You Need

- 8 marshmallows
- 18 pieces of raw spaghetti
- 4 pieces of raw linguine (spaghetti and linguine should be same diameter)
- 1 paper clip
- 1 envelope and a scissors (to make hanging basket for coins)
- approximately 40 coins
- paper and pencil to record observations

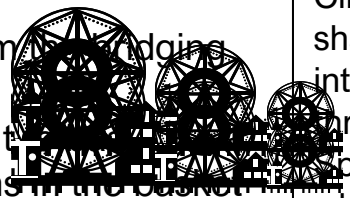






To Do and Observe

1. Cut off the lower corner of the envelope for your coin basket.
2. Unbend one end of the paperclip to make a hanger and poke it through the top of your coin basket.
3. Construct two pyramids of equal size with your marshmallows and spaghetti.
4. Connect the pyramids with a single strand of spaghetti.
5. Hang your coin basket from [illegible] bridging piece of spaghetti.
6. Add coins one at a time to t[illegible]
7. Record the number of coins [illegible] at the time the bridging spaghetti breaks.
8. Repeat the experiment three more times to get an average number of pennies needed to break the spaghetti bridge.
9. How do you think the results will change if you use linguine for the bridge instead?
10. Test your hypothesis by repeating the experiment with the linguine as the bridge.
11. Was the round (spaghetti) or flat (linguine) shape stronger?



Number of coins held by spaghetti			Number of coins held by linguine		
Av:			Av:		

What's Going On

Circles are among the strongest shapes in nature. External and internal stress distributes itself evenly throughout a round structure. Spaghetti has a shape like a cylinder, while linguini is shaped like a flattened rectangle. A piece of spaghetti has the same strength in any direction it is bent. Linguini will bend more easily in one orientation than another.

Be sure to experiment using pieces of spaghetti and linguini with similar diameters. And try orienting each piece of linguini in the same direction; this will produce a more uniform strength throughout the structure.

DESIGN TECHNOLOGY - STRUCTURES - interesting websites

Many thanks to John Allen, INPUT and Sylva Starke, Dorset Construction Curriculum Centre.

http://www.input.uk.com/ - Input seeks to support the development of the next generation of highly qualified science and technology personnel. Its targets to achieve this are students, teachers, schools and industry.

http://www.infoplease.com/ipa/A0001328.html - world famous structures

http://www.teachers.ash.org.au/jmresources/structures/famous.html - famous structures

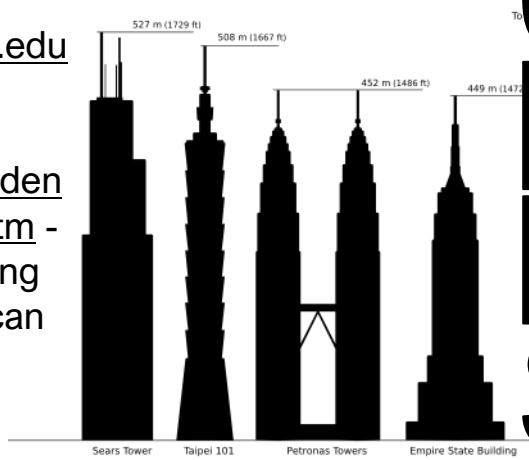
http://www.mcps.k12.md.us/schools/forestknollses/projects/structures.html - famous structures

http://www.technologystudent.com/struct1/wlrdstr1.htm - structures quiz

http://www.yesmag.ca/focus/structures/structures.html - all about structures

http://www.exploratorium.edu/structures/ - structures around the world

http://www.technologystudent.com/struct1/struindex.htm - interesting website showing how different structures can be made



STRUCTURES

http://greatstructures.info/ - great structures of the world

http://www.skyscraperpicture.com/index2.htm - great skyscraper photos

http://www.terragalleria.com/pictures-subjects/buildings-and-structures/ - great structure photos

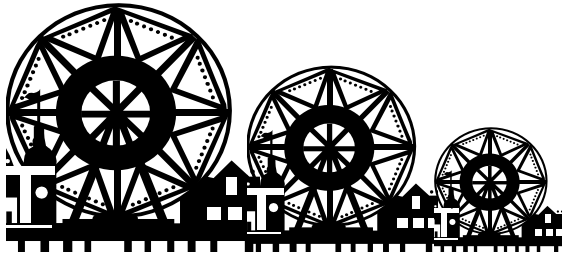
http://architecture.about.com/od/greatbuildings/Great_Buildings_and_Structures.htm - more info on great buildings and structures

http://en.wikipedia.org/wiki/Supertall - super tall buildings

http://www.ul.ie/~gaughran/Gildea/page1.htm - natural forms and structures

http://www.pennridge.org/works/structnat1.html - structures in nature

http://www.projects.yrdsb.edu.on.ca/structures/nature.htm - a picture quiz



DT WORDSEARCH STRUCTURES

* useful words * useful words *

D E S I G N T E C H N O L O G Y 2 0 0 7
M D O P N 1 H H R P E R N N G Q M I T M
H O B W O C 0 E E L A O E R Q I O T C D
T D S D R N P 1 G X I N E P L T N T E R
H E E A I A T N I S A A T A A O F E J E
E C R E P M A C N E T G U H I P N H O V
G A V 3 R I A E H B P D O S E Q 4 3 R E
H H A S R E P R E A E A N N F O D A P L
E E T T E S H I Y Y R E T B P I N P N I
R D I N U R J P A P T T N J M M Q S E T
K R O S O I U T S Q U A R E B A S E D N
I O N W N I S T L O B D N A S T U N E A
N N E G H E S R C M I S B R I D G E T C
T J B M L E T S W U I B E A M N D A O L
O I L B O X E Q E O R E L G N A T C E R
W S A R O D X L N R M T P E N T A G O N
E C X F A B K S F U P V S P O R D M U G
R I D F S N O I S N E M I D 2 D X J A N
M I L L E N N I U M U Y O S U P P O R T
N O G A T C O Y D U N T N C N T O W E R

2 DIMENSIONS
3 DIMENSIONS ARCH
A4 PAPER
BEAM
BIOSPHERE
BRIDGE
CABLE STAYED
CANTILEVER
CN TOWER
COMPRESSION
DESIGN TECHNOLOGY 2007
DODECAHEDRON
DOME
EDEN PROJECT
GREAT BEIJING
GUMDROPS
HEXAGON
LOAD
MILAU
MILLENNIUM
NUTS AND BOLTS
OBSERVATION
OCTAGON
PANTHEON
PENTAGON
PONTCHARTRAIN
PYRAMID
RECTANGLE
SPAGHETTI
SQUARE BASED
STRUCTURES
SUPPORT
SUSPENSION
TAPEI 101
TENSION
THE GHERKIN TOWER
TRIANGLE
WHEEL

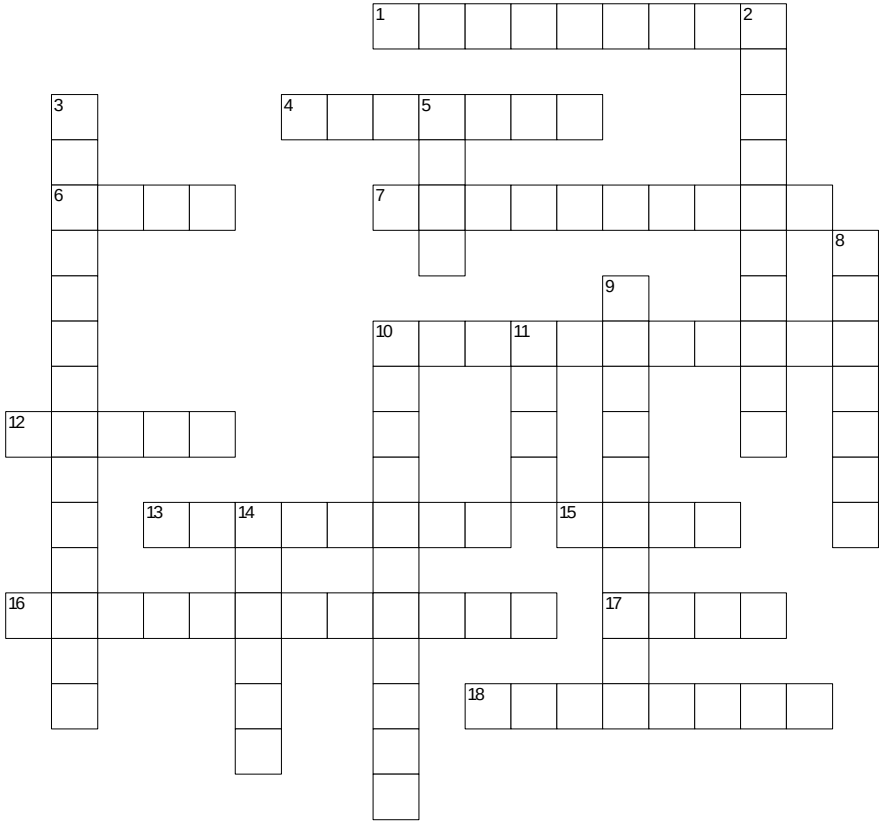
STRUCTURES

How many words of 3 letters or more can you make out of the word STRUCTURES. You can only use the letters the same number of times as they appear in the word.

S T R U C T U R E S

STRUCTURES

Bridge Structure Crossword Puzzle



Word Bank

Abutments	Arch	Beam bridge
Cable stayed	Cantilever	Compression
Deck	Engineer	Girder
Moveable	Pier	Pile
Span	Substructure	Superstructure
Suspension	Tension	Torsion
Truss		

ACROSS

1 The supports at each end of the bridge.
4 The act of twisting.
6 The solid surface for the piers and abutments to rest upon.
7 Beams extend from each end and hold up a suspended span.
10 The act of pressing or pushing.
12 A rigid triangular framework.
13 A person who designs and constructs structures and machines.
15 A bridge where the load is transferred along the curved section to the abutment or pier.
16 The part that holds up the bridge.
17 The platform extending horizontally, often supporting the roadway.
18 Bridges designed so that a portion can move to allow large vehicles to pass underneath.

DOWN

2 Bridge with tall towers supporting cables that runs the entire length of the bridge.
3 The part of the bridge that rests on the foundation.
5 Portion of the bridge between two supports.
8 The act of stretching.
9 The type of bridge where piers support beams that support the spans of concrete.
10 Bridges similar to Suspension Bridges except the cables are connected directly to the roadway.
11 the vertical supports used to keep the bridge from sagging.
14 A horizontal beam used for support.