PAPER PILLARS

Discover which paper shapes are the strongest

Overview

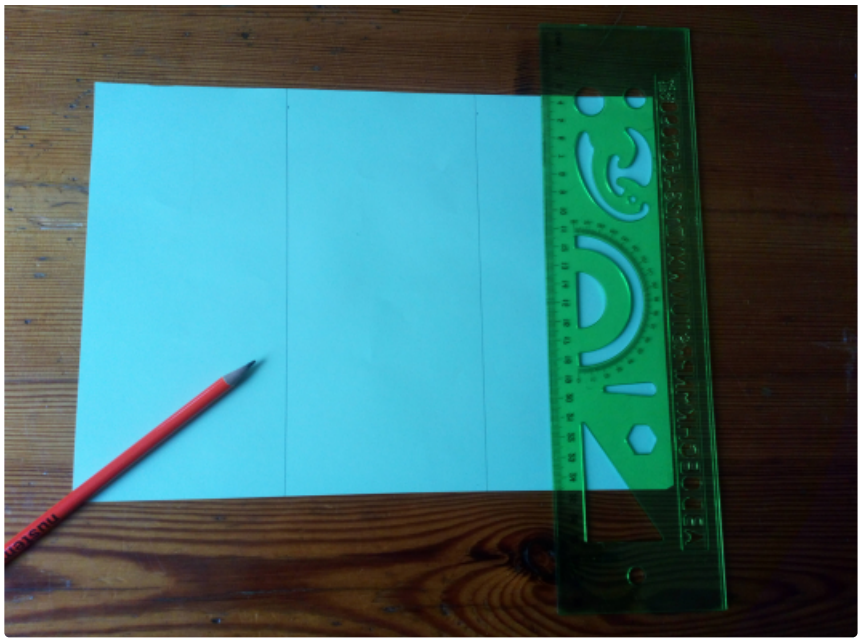
During this investigation you will discover which shape of paper tower can hold the most books before they collapse. All you need is paper, a ruler, a pencil and some sticky tape and you are ready to start.

Printable version

This page will print, but looks a little funky. Click the button for a PDF version which looks a bit better.

What to do

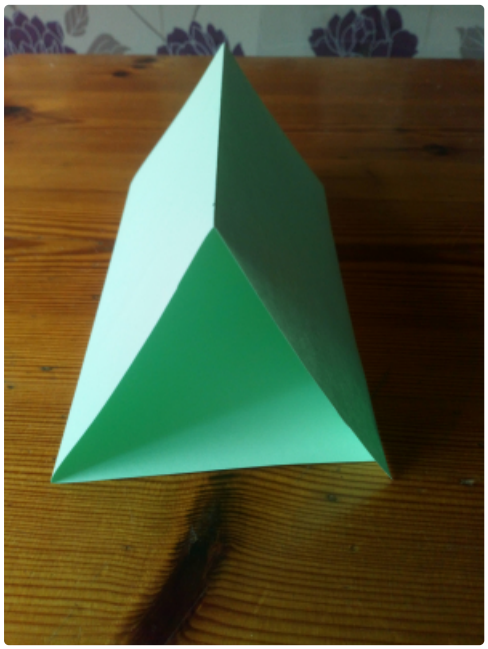
Step 1



Your investigation begins by making three paper pillars: a cylinder, a cuboid and a triangular prism.

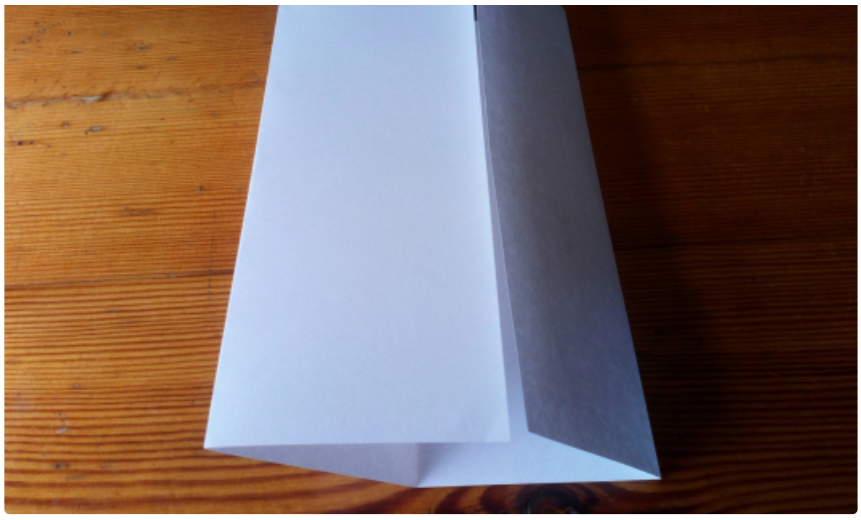
To make your triangular prism, turn your paper width ways (landscape) and divide it into 3 with your ruler. If you are using A4 paper, this is about 10 cm per section.

Step 2



Now fold along the lines to make your triangular prism pillar.

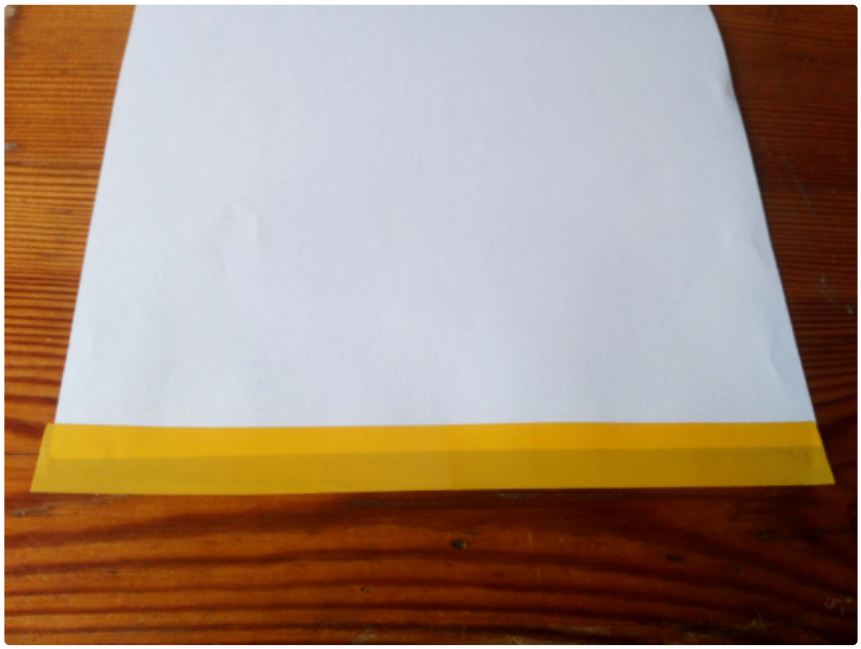
Step 3



To make your cuboid pillar, turn a second piece of paper width ways (landscape). Fold the paper in half, then fold each half in to the centre.

To make your cylinder pillar you just need to stick the two short edges of your paper together.

Step 4



The tricky bit is sticking your shapes together.

Put one of the short edges of your paper flat on the table or surface you are using. Cut a piece of sellotape and stick it along the short edge of your paper, so it is half on, half off, as shown in the photograph.

Smooth the down the tape on the paper. Try not to stick it to the table!

Step 5

Turn the paper over so that the sticky side of the is upwards. Put the other short edge of the paper on top of the sticky taped edge, matching the corners and edge together, as if you were folding the page in half.

Don't push down!

Instead, carefully fold the sticky tape over the edge to stick the two short sides of the paper together.

Step 6

Time for testing!

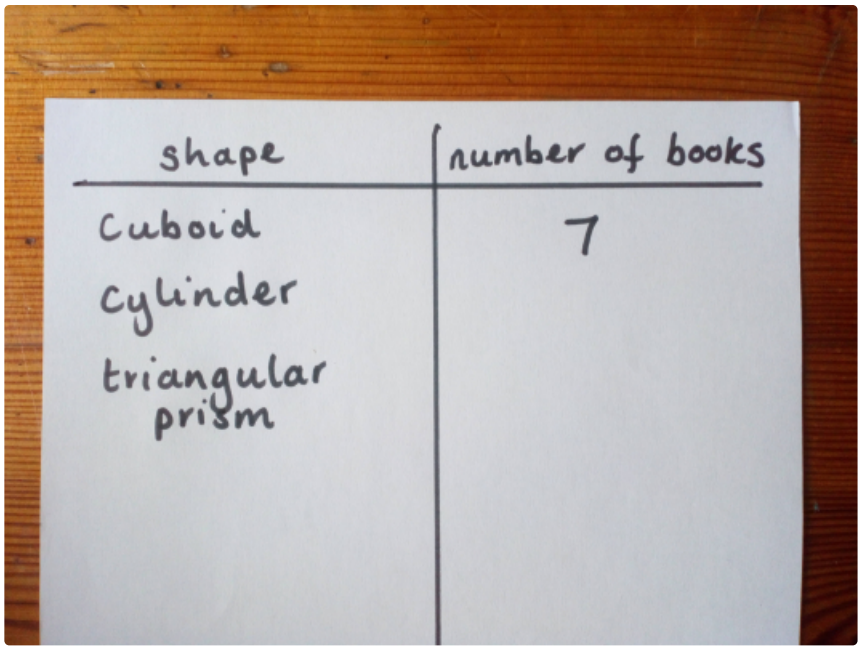
Which pillar do you predict will hold the most books?

Put your first paper pillar, upright in a space on a flat surface.

Very carefully, place one book (or whatever you are using as a weight) on top of your pillar. Make sure the pillar is right in the centre of the book.

Keep adding books until the pillar can no longer withstand the weight and collapses.

Step 7



Test all three of your paper pillars and see which one can hold the most books. You could record your results in a table like the one in the photograph.

Step 8

Try making some different shapes.

Try making some different shapes.

If you are using A4 paper the width is about 30 cm, so you could make a pentagonal prism by dividing your page into five sections of 6 cm, a hexagonal prism by making six sections of 5 cm or a decagonal prism with 10 sections of 3 cm.

We made our octagonal prism by folding the paper in half, into quarters and each quarter in half again to make eighths. Test each one and record your results on your table.

Things to discuss

Time to look at your results table.

Which pillar held the most books? Which pillar held the least? Why do you think that is?

Does the number of corners (vertices) and faces make a difference? Do shapes with more vertices and faces hold more books?

Do odd numbers or even numbers of vertices and faces make any difference to the results?

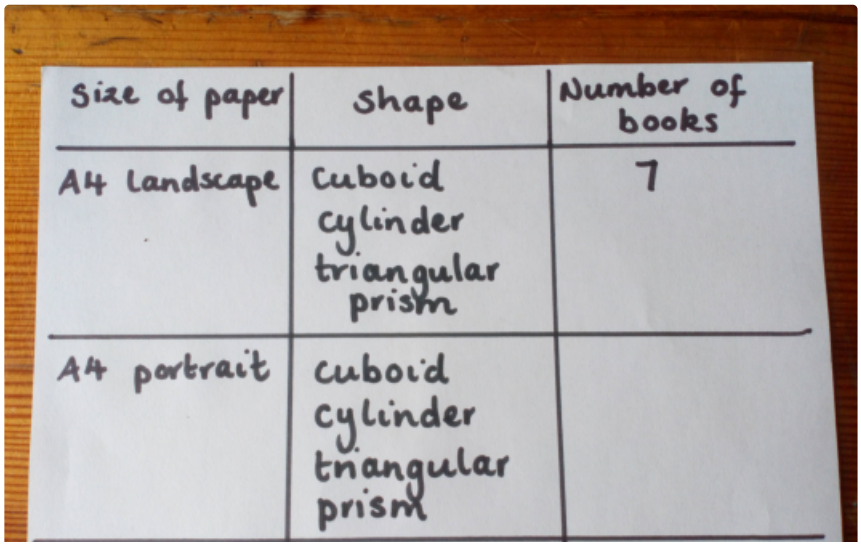
Have you noticed any patterns of your own?

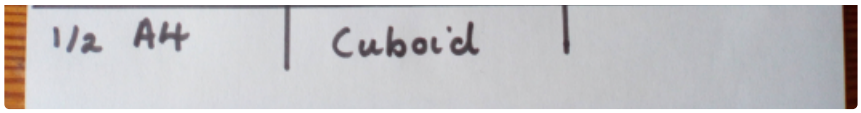
How it works

Your investigation was about creating the most support for your weight using the material available. Even though each of your paper pillars was made out the exactly the same material, you probably found that the cylinder was the strongest. This is because each point on the surface of a cylinder is an equal distance from it's centre so the weight of the books, or load, can be equally spread through the pillar. With the cuboid and triangular prism pillars, some points (the folds) are further away from the centre and are areas of weakness. Cylinders don't have any folds, so they don't have any points of weakness.

Other things to try

What happens when you test different size pillars?





What do you think will happen if you make your pillars taller or shorter?

If you are using A4 paper, turn it length ways (portrait) and repeat the experiment.

What happens if you make your pillars shorted? You could try cutting your paper in half and in quarters and repeating the investigation.

You can record your results in a table like the one in the photograph so you can compare them easily.

Do taller or shorter pillars hold more weight?

Did you spot any patterns in your results?

How high can you build using your pillars?

You may have noticed in buildings that two pillars or columns hold up a beam or lintel that supports the wall above.

You could now test how tall a structure you can build using your pillars as supports and your books as lintels.

Look back at your results and decide on the best shape and size pillar. This will be the one that held the most books. You will need to make quite a few pillars then start constructing!

How high did you get your structure?

How do you think you could improve your structure?

How could you make it more stable?

What else can you build?

You could try building different structures using your pillars and books.

Which was the tallest structure you built?

Which was the most stable?

Why do you think this is?

More STEM at Home

What you'll need

- Paper – 3 pieces the same size and thickness. We used A4 but you can use any size.
- Sticky tape
- Ruler
- Pencil
- Books – these need to be about the same size and weight. You could use other objects of the same size and weight for your testing, e.g. coins or cutlery (don't use anything that will smash!)
- Scissors (for the additional activities)

Duration

30 minutes or so.

Suitable for...

Age 4 and up, although younger children will need help and close supervision.

Safety notes

You know your children better than anyone, and you should judge whether they're ready for this activity. You might want to think in particular about:

- Supervision when using scissors
- This activity causes the paper pillars to collapse. You will need to be in a large space on a surface that won't be damaged by falling books or other items.
- Children may require close supervision during the testing phase to avoid getting in the way of falling books/other items.

Careers link – Architect

Architects plan and design structures such as houses, schools, office buildings, stadiums and shopping centres. They may even plan and design outdoor spaces. Architects need to visit the site location so they can visualise what their structure will look like, then prepared scaled drawings for the person employing them. Architects need to take into consideration factors such as environmental impact, planning laws and disability access.

The skills and attributes you need to be an architect are imagination, observation and organisation.

Buildings with pillars in our local area

There are lots of examples of pillars or columns in architecture. Look carefully at the shapes of the columns on these structures. Why do you think the different shaped pillars have been used?

Can you find any examples in your local area? You may find them in your street or you may find examples in nature.

Theatre Royal

City Hall

Newcastle Central Station

Grey’s Monument

Tyne Bridges

Dunston Staithes

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