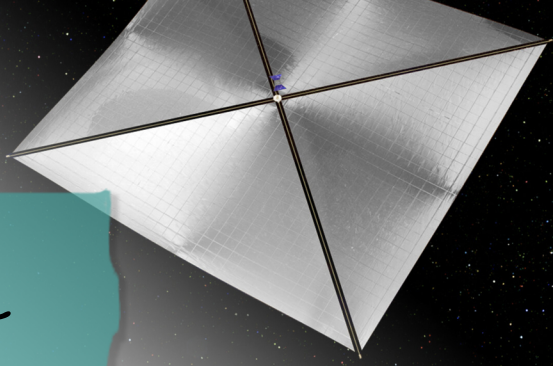


SEE HOW

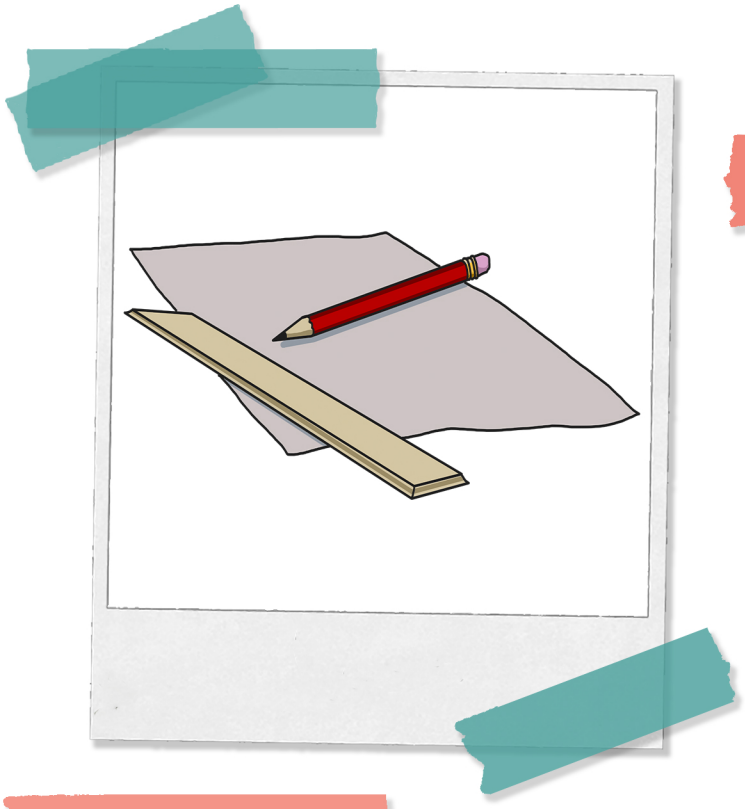
Satellite Parts Pack into Small Spaces

They say good things come in small packages. This is especially true when it comes to satellites!

When lifting things into orbit, everything has to fit inside a rocket. You want every circuit, sensor, and solar panel to occupy as little space as possible. Here's how engineers use clever folding tricks to squeeze large objects into the tightest spaces.

WHAT YOU'LL DISCOVER

The art of origami can be used to neatly reduce the size of large surface areas into small volumes, allowing for their easy expansion again later. Just the thing to get a solar panel, Sun shield, or parachute into space.



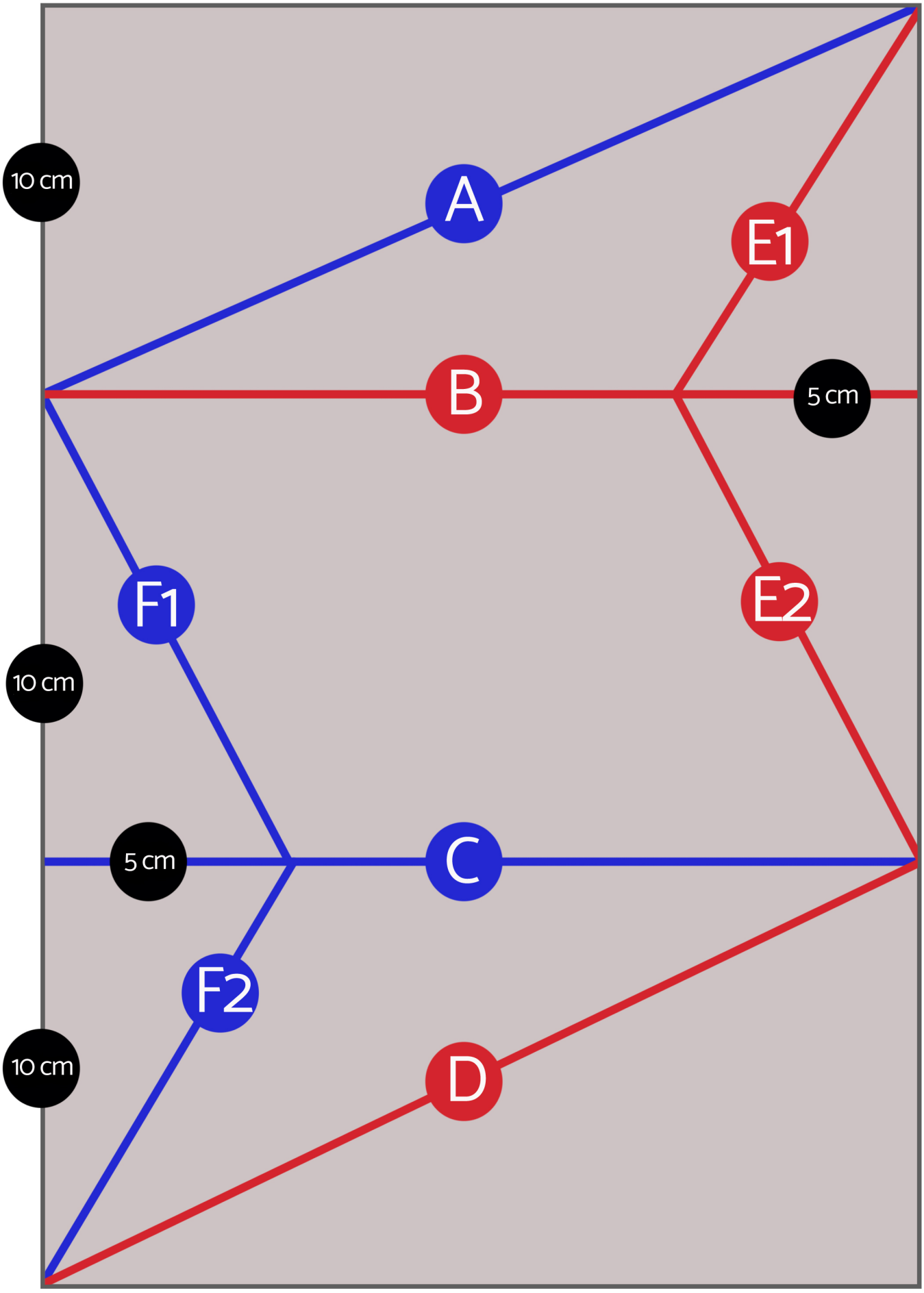
What you need

- An A4 sheet of paper (80 gsm printer paper works fine, but slightly heavier paper works a bit better)
- A lead pencil
- A 30 centimetre ruler

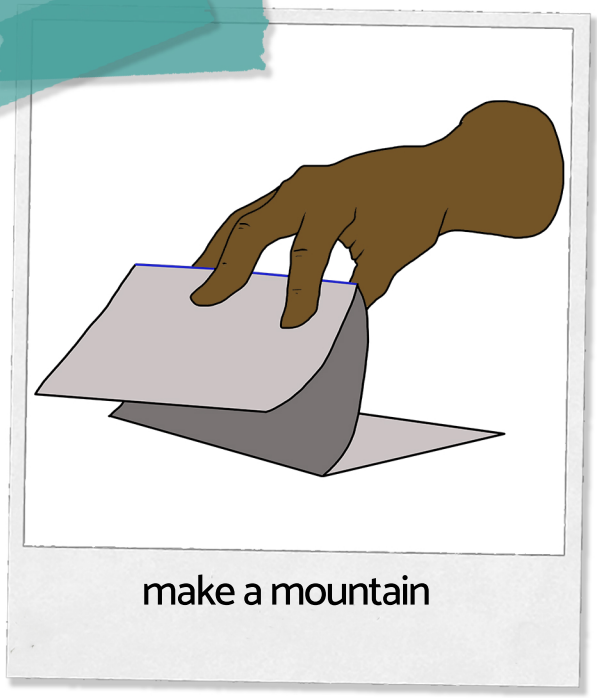
How to build

1. Place your A4 sheet of paper on a cleared, flat surface (such as a table top) in a portrait position (long sides to your left and right).
2. Copy the blue and red lines of the template on the following page (or print out the page). You don't need to copy the colours or the letters – they'll be used as references later.

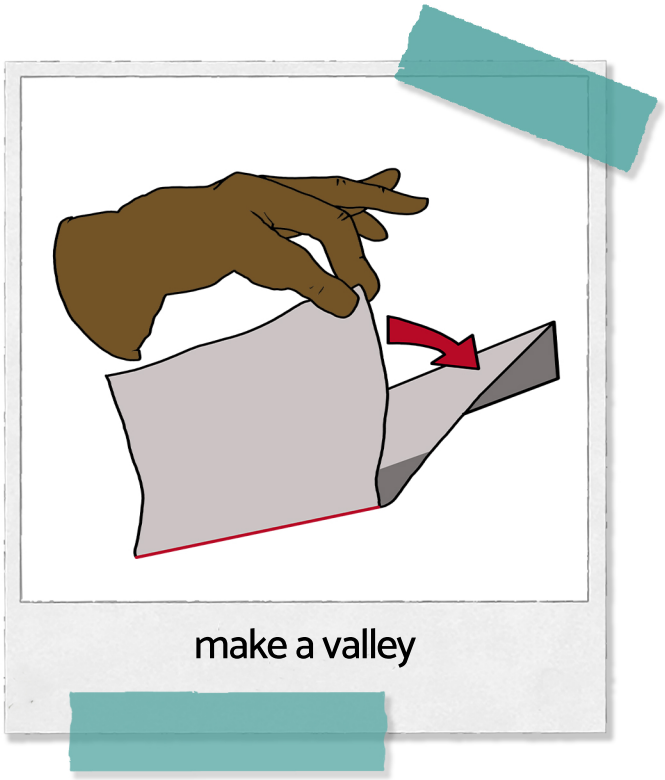
NOTE: Make sure you use a ruler and pay attention to the measurements. Each section is roughly 10 centimetres tall. The smaller sections on lines **B** and **C** are 5 centimetres long.



Template for a simple Miura fold.



make a mountain

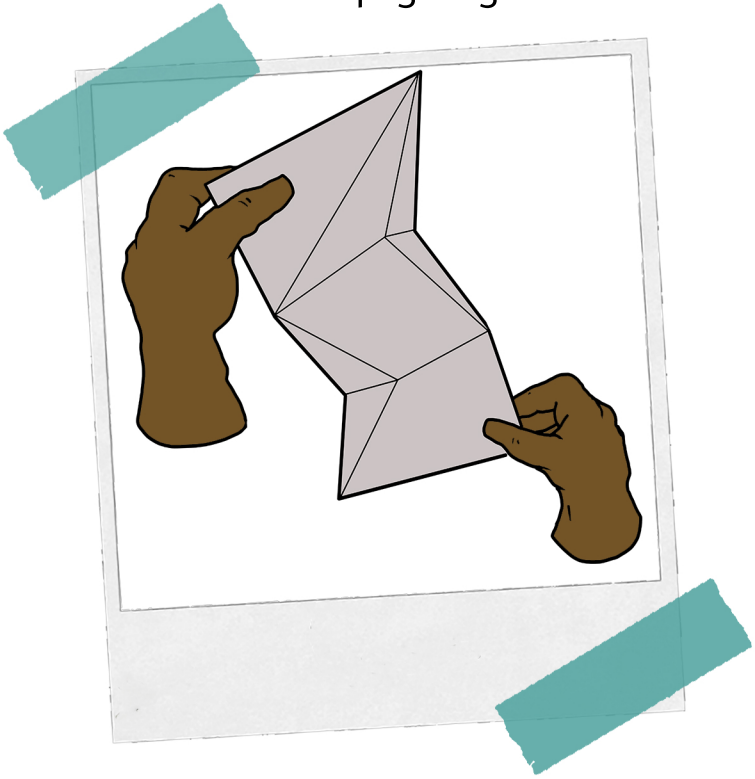


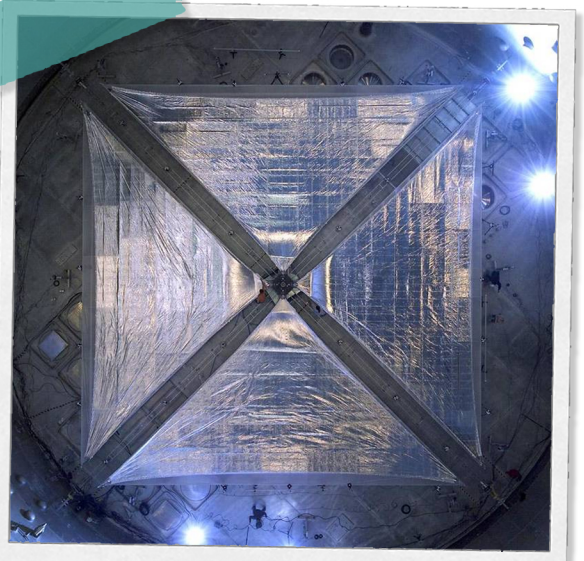
make a valley

How to use

NOTE: Creasing the paper so a fold points up will be 'make a mountain'. Creasing the paper so a fold points down will be 'make a valley'.

1. Make a mountain along the line labelled **A**.
2. Make a valley along the line labelled **B**.
3. Make a mountain along the line labelled **C**.
4. Make a valley along the line labelled **D**.
5. Now for the tricky bits! Crease lines **E1** and **E2** to make valleys. The smaller section of line **B** towards the right side of the page will need to be folded into a mountain as you do this.
6. Crease lines **F1** and **F2** to make mountains. The smaller section of line **C** near the left side of the page will need to be folded into a valley as you do this.
7. To fold the sheet into a smaller area, make sure all of the creases are pointing the right way. Use your right hand to pinch the top right corner to fold line **A** into a mountain and **E1** into a valley. Use your left hand to pinch **F2** into a mountain and **D** into a valley.
8. Gently push them together, so lines **B** and **C** fold in on themselves. Bring each third of the page together.



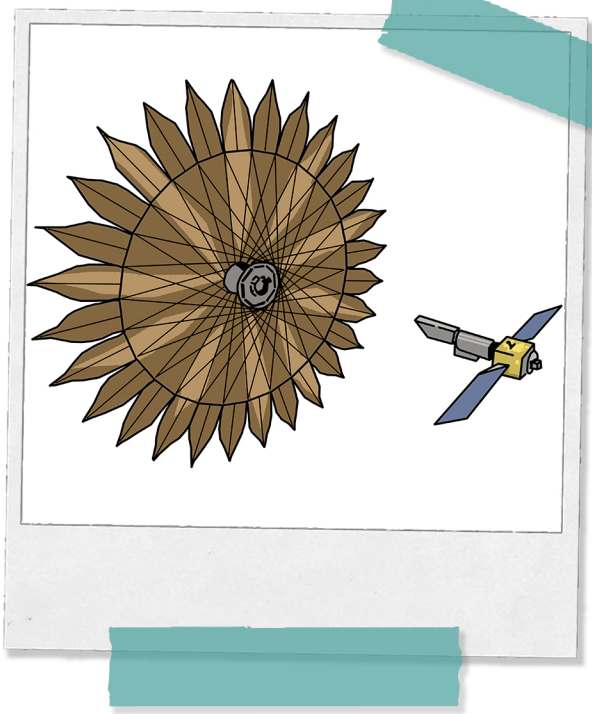


four-quadrant solar sail

NASA has also used clever folding techniques to shrink an umbrella-type "starshade" for a space telescope.

The telescope has the job of capturing images of planets around distant stars, but it's difficult to pick out the light of a planet from the brighter light of its star.

A starshade is used to block out the star's blinding light, much like you'd use your hand to shield your eyes from the Sun's glare on a bright day.



HOW IT WORKS

This is a type of origami called a Miura Fold. It is named after the Japanese astrophysicist, Dr Koryo Miura, who realised this particular arrangement of creases could be useful in space technology.

The folded sheet in this activity is as simple as the Miura fold gets. Far larger versions with more creases have been used by the Japanese Aerospace Exploration Agency (JAXA) to shrink large 2D surfaces for easy transport.

One example was for the Interplanetary Kite-craft Accelerated by Radiation Of the Sun (IKAROS) mission. It used the Sun's rays to push it along, like a giant sail uses the wind.

The square sail was 20 metres across the diagonal, and had to be packed into a small space before being launched. A Miura fold helped shrink it down in size.

Challenge activity

If you're up for the challenge, NASA has instructions for making your own origami starshade at:

jpl.nasa.gov/edu/learn/project/space-origami-make-your-own-starshade/

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