

Next Generation Satellite

6 Week STEM Clubs



Aim

To introduce the challenges facing satellite engineers in balancing the demands for mission-critical instrumentation with the weight constraints when launching satellites into space by designing and building a 3D next generation model satellite

Introduction

Satellites can help scientists get a better understanding of the planets in our solar system as well as capture images of distant galaxies.

Satellite engineers can choose from a wide variety of scientific instruments that can gather and collect data, although all satellite designs will carry three common items (i) communications unit - to transmit data back to Earth (ii) orientation unit - to get positional data from the sun and stars, similar to a compass (iii) power unit - to provide electricity to the electronics, using solar panels / rechargeable batteries.

Lots of designs have already been developed and built by satellite engineers, and have now been launched into space. More continue to be developed and the data being sent back to Earth is leading to more cosmic discoveries.

Activity

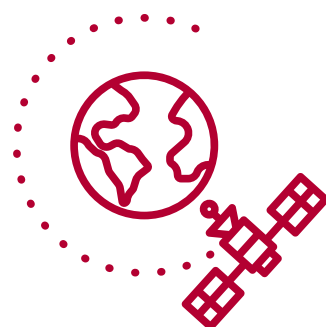
Equipment

- Stiff Card
- Paper
- Pencil
- Ruler
- Scissors
- Glue
- Stapler
- Sticky tape
- 3D templates / examples
- Satellite information table

Instructions to make your 3D model satellite

- 1** In your teams decide on your satellite's mission. You might want to study conditions on a planet, maybe take pictures or even find other planets in the universe
- 2** Give your mission a name
- 3** Using the Satellite Information Table decide on:
 - The instruments you need
 - The amount of solar cells needed to power instruments
 - The number of batteries for each solar cell (to keep things powered if it's in darkness)

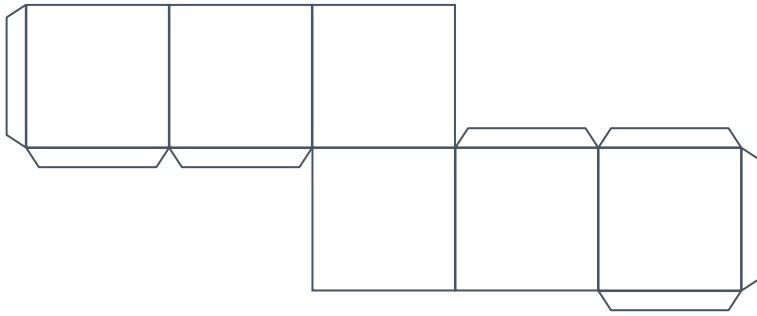
N.B. The maximum combined satellite weight is 70kg so you might need to make compromises or rethink your mission – problem solving is part of engineering
- 4** Once you have finalised your mission, sketch two or more possible designs, add labels, modifying your design as necessary
- 5** Describe your ideas to the other teams
- 6** Finally, build your satellite model using card. The 3D template / example sheet shows how 3D forms can be created from flat card and might spark some ideas in your model building



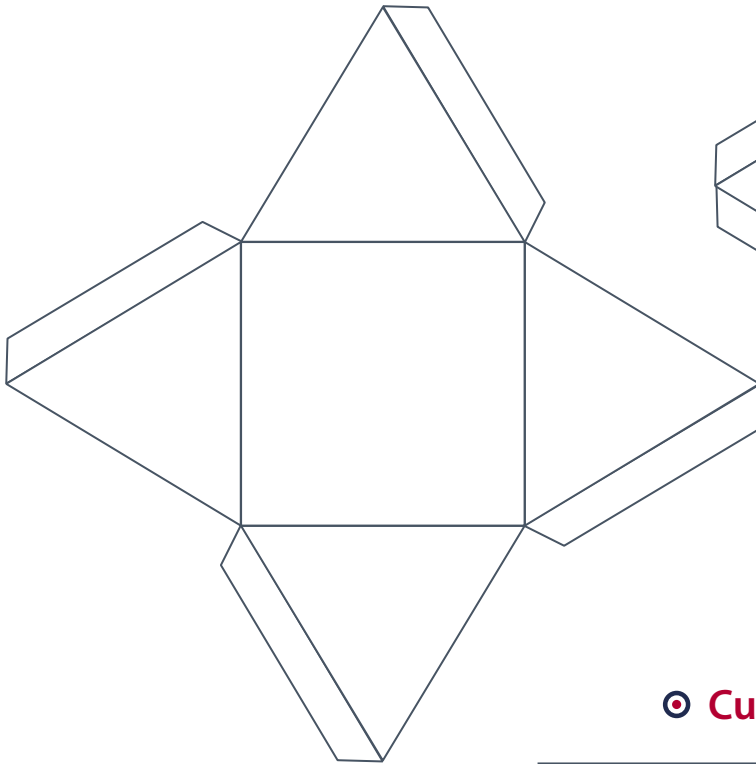
In association with

3D templates / examples

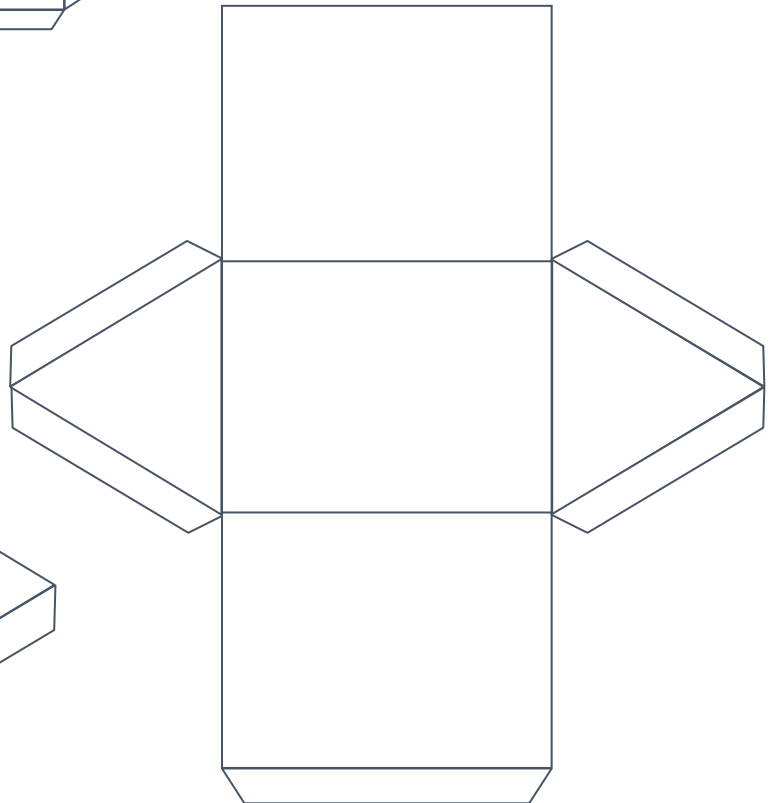
◉ Cube



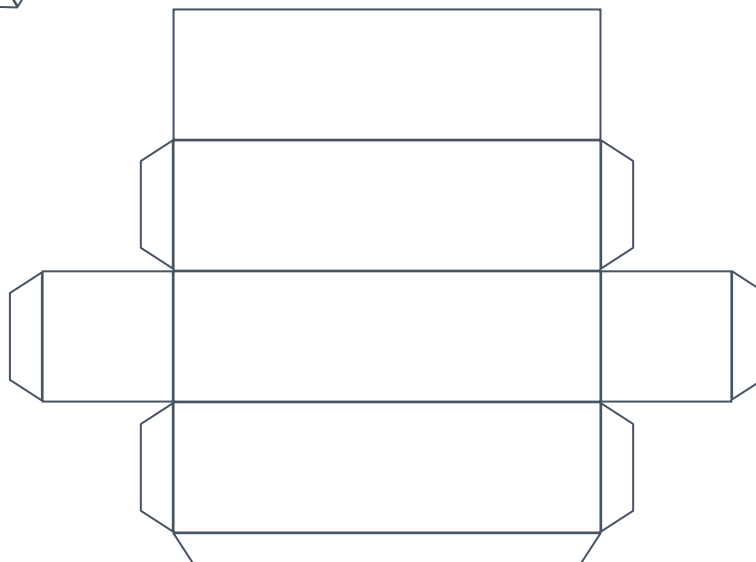
◉ 4 Sided Pyramid



◉ 3 Sided Prism



◉ Cuboid



Satellite information table



| Instruments | Function | kg | Solar Cells Needed |
|------------------------------|---|----|--------------------|
| Laser Altimeter | Maps the surface features by determining their height | 2 | 2 |
| Gravity Probe | Measures gravity fields across the planet's surface | 12 | 1 |
| Magnetometer | Maps the magnetic field of the planet | 9 | 0.5 |
| Heat Sensor | Measures surface temperatures across the planet | 8 | 0.5 |
| Radar | Captures data about materials beneath the surface | 3 | 0.5 |
| Imaging Spectrometer | Identifies the type of surface by its chemical composition | 12 | 2 |
| High-Resolution Camera | Captures close-up images of the planet's surface | 25 | 2 |
| Context Camera | Captures wide-angle images of the planet | 10 | 1 |
| Solar Wind Particle Analyzer | Measures solar winds and interactions with the atmosphere | 8 | 1 |
| Orientation Device | Gathers tracking data of the satellite's position in space | 3 | 1.5 |
| Communications Antenna | Receives instructions and returns data back to Earth | 4 | 1 |
| Rechargeable Battery | Provides power to the satellite when it's not in sunlight | 6 | 1 |
| Solar Cells | Converts sunlight into electricity to power the electronics | 1 | |



Useful links

- So, you want to build a satellite? <https://tinyurl.com/4gpbw93w>
- Satellite Launch and Deployment Sequence <https://tinyurl.com/1rfk5bou>
- Designs already in space – examples <https://tinyurl.com/1cnzo06q>



Next steps

- The 2D cube layout shown in the 3D templates / examples, is just one layout, from many, that will all still form a 3D cube. How many other 2D cube layouts can you come up with (there's more than 10).
- Lots of 2D shapes can fold into 3D models - see how many you can find (eg) Hexagonal and Pentagonal prisms, Tetrahedron, Octahedron, Dodecahedron