Next Generation Satellite

6 Week STEM Clubs

ROYAL AIR FORCE Youth & STEM

Aim

Children are introduced to the challenges facing satellite engineers in balancing the demands for mission-critical instrumentation with the weight constraints when launching satellites into space

Introduction

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

Also, 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 - using solar panels / rechargeable batteries, providing electricity to the electronics.

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.

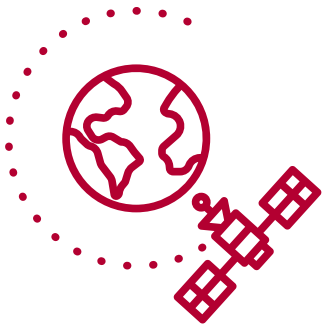
Activity

Equipment

- Stiff Card
- Paper
- Pencil
- Ruler
- Scissors
- Glue
- Stapler
- Sticky tape

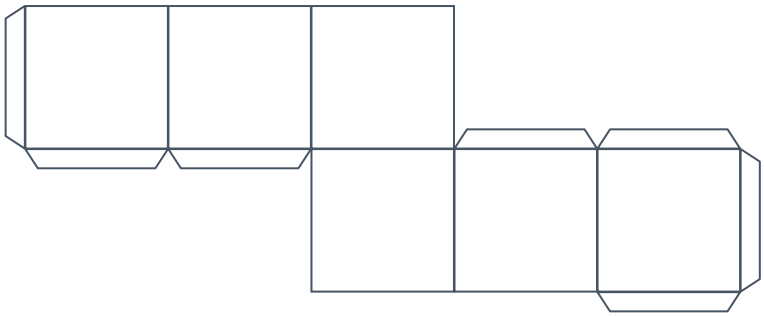
In this activity, you are going to design and build a model of your next generation satellite. Your design will perhaps study conditions on a planet, maybe take pictures, or even find planets elsewhere in the universe.

1. In your teams, decide on your satellite's mission, the instruments needed and the mission name
2. Select the instruments from the table overleaf and add up the combined weight of the instruments
3. Next calculate the total number of solar cells needed to power all your instruments and whether a battery will be assigned to each solar cell (to keep things powered up if it's in darkness)
4. Add up the combined weight of the power units - solar panels/batteries
5. Now add up your total combined satellite weight (electronics and power) - the design constraint is that your maximum weight is 70kg; above this and your satellite is too heavy to launch. You may have to make compromises or rethink your satellite's mission - this is part of engineering
6. Once your team has finalised the satellite's mission, sketch two or more possible designs, add labels and annotations and describe them to other teams, modifying your designs as necessary
7. Finally, build your satellite model using card. The shapes overleaf show how 3D forms can be created from flat card and might spark some ideas in building your model

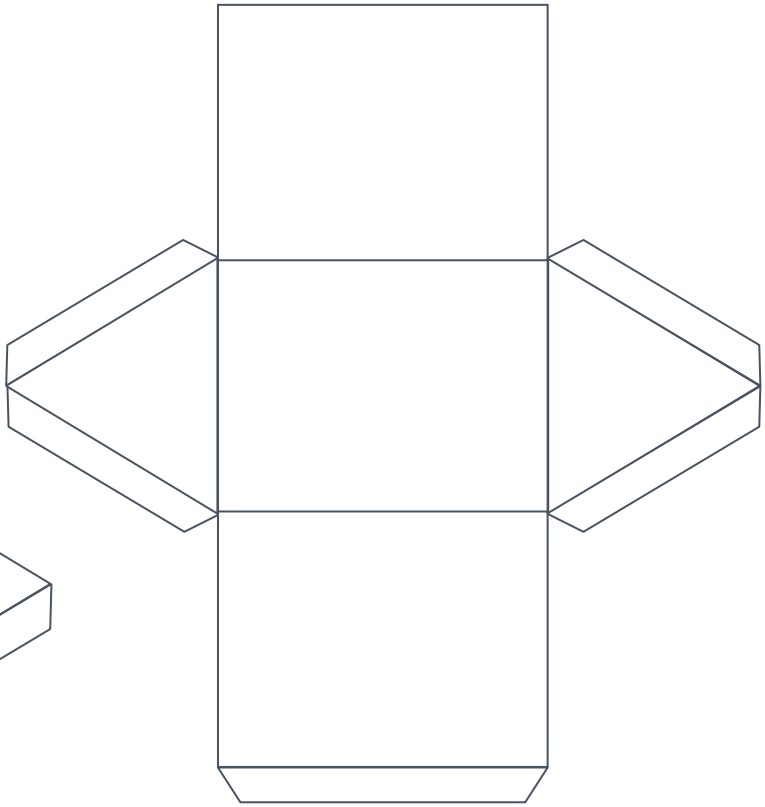


In association with all about STEM

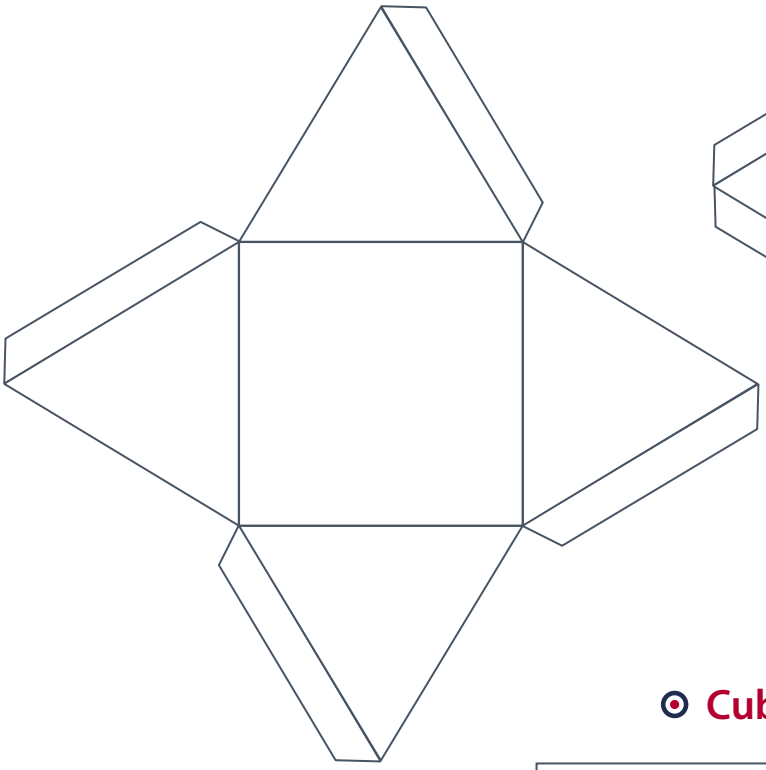
Cube



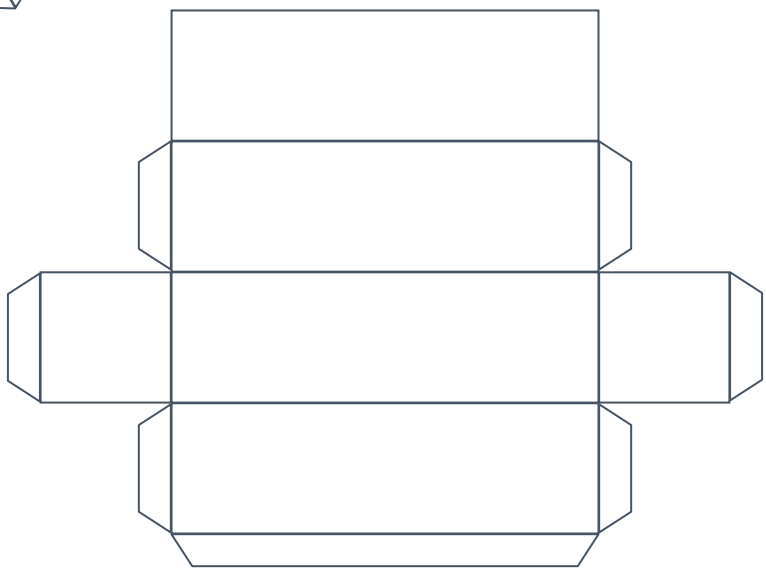
3 Sided Prism



4 Sided Pyramid



Cuboid



ROYAL AIR FORCE
Youth & STEM

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 return 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

SCAN ME

- 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 previously, 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