SATELLITES

TEACHER / FACILITATOR PACK

Materials developed on behalf of the Royal Air Force to support Glasgow Science Centre Learning Lab.

Materials appropriate for S1 to S5 pupils.

Lesson objective	To look at satellites and how they are used now and in the future. To investigate the technology and how satellites are deployed. To look at satellite projects across the world.
Duration	Approximate **total** duration of all activities in this resource pack: 1.5 hours. Indicative timings provided for each component.
Context to set the scene for the session	A satellite is an object that orbits a planet. There are thousands of man-made satellites in our solar system. The first, launched by Russia in 1957 was very simple and used radio waves to emit beeps. Modern satellites are more complicated. They are designed to be as strong and light as possible. They contain all the main systems, including the batteries, computer and thrusters and other instruments such as cameras, telescopes and communications equipment.

Scottish curriculum links

This activity provides links to experience and outcomes in a number of subject areas covered by Curriculum for Excellence. Specifically, these include:

By safely observing and recording the sun and moon at various times, I can describe their patterns of movement and changes over time. I can relate these to the length of a day, a month and a year. **SCN 1-06a (Space)**

By observing and researching features of our Solar System, I can use simple models to communicate my understanding of size, scale, time and relative motion within it. **SCN 2-06a (Space)**

By using my knowledge of our solar system and the basic needs of living things, I can produce a reasoned argument on the likelihood of life existing elsewhere in the universe. **SCN 3-06a (Space)**

I have collaborated in investigations into the effects of gravity on objects and I can predict what might happen to their weight in different situations on Earth and in space. **SCN 3-08a (Space)**

By researching developments used to observe or explore space, I can illustrate how our knowledge of the universe has evolved over time. **SCN 4-06a (Space)**

I understand how scientific and technological developments have contributed to changes in everyday products. **TCH 3-05a (Awareness of technological developments)**

I can evaluate the implications for individuals and societies of the ethical issues arising from technological developments. **TCH 3-06a (Impact, contribution, and relationship of technologies on business, the economy, politics, and the environment)**

I can explore the impact, contribution and use of various software applications and emerging hardware in business. **TCH 3-08a (Impact, contribution, and relationship of technologies on business, the economy, politics, and the environment)**

I can apply my knowledge and understanding of engineering disciplines and can develop/build solutions to given tasks. **TCH 3-12a (Application of Engineering)**

I can present conclusions about the impact of technologies on the economy, politics and the environment. **TCH 4-07a (Impact, contribution, and relationship of technologies on business, the economy, politics, and the environment)**

I can apply design thinking skills when designing and manufacturing models/products which satisfy the user or client. **TCH 4-09a (Design and constructing models/product)**

Pupil resources

- Introductory video explainer
- Satellites Factsheet
- Worksheet: Satellites wordsearch
- Worksheet: Satellite identification activity
- Worksheet: Artemis Team video activity
- Worksheet: Design a satellite activity
- Worksheet: Satellites quiz

Hook into the lesson (10 mins)

Play **INTRODUCTORY EXPLAINER**.

Additional context

Satellites help scientists to get a better understanding of the planets, including Earth.

All satellites contain three main components: (1) A power unit which provides electricity to the electronics using solar power and rechargeable batteries. (2) Orientation units which work like a compass and provide positional data from the sun and the stars. (3) Communication equipment to transmit data back to Earth. Communication is extremely important in making sure the correct instructions get through to the satellite, and to make sure that the correct information and data are sent back to Earth.

There are many different types of satellites that contain a wide variety of scientific instruments with different functions. Some of these include satellites that take pictures of the sun, planets, galaxies and look deep into black holes. There are also communications satellites, weather satellites, and satellites that people can live in - such as the International Space Station.

The International Space Station (ISS) is a big satellite that people can live in for a long time. It is being built in space right now. It is an international project undertaken between the USA, Russia, Europe, Japan, and Canada.

Satellites travel really fast. Some complete a full revolution of the Earth in just 100 minutes. And within around a couple of weeks they can scan the entire Earth, one strip at a time covering 230 revolutions!

That's great, but nearly all satellites can only take still images. A new kind of satellite, being used by the RAF, allows moving images (in high definition) to be captured each time the satellite passes overhead. With a moving image we can learn much more about what's going on beneath the satellite. We can see if vehicles have moved and how fast they have moved, we can see aircraft taxi-ing and taking off, we can see changes to the landscape caused by mining or other activity, we can see major events as they happen.

Provide pupils with a copy of **Satellite FACTSHEET.**

Activity (10 mins)

Ask pupils to think of the different functions that satellites provide.

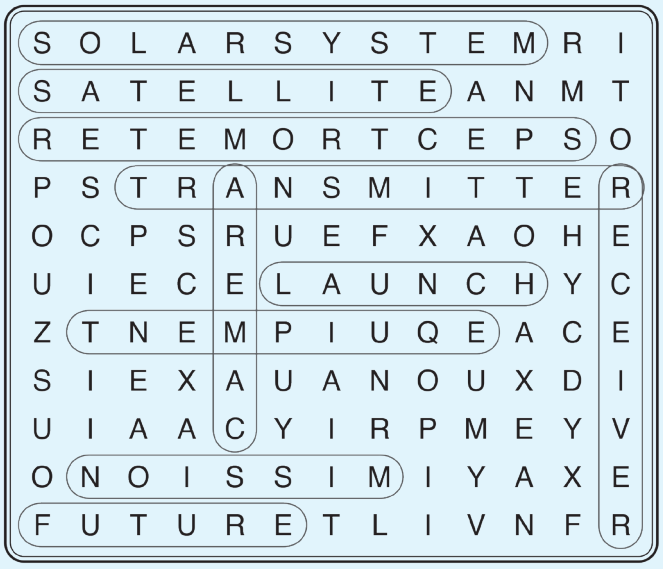
Lead a discussion with pupils that explores components and uses of satellites.

Provide pupils with a copy of **Worksheet: SATELLITE IDENTIFICATION.**

Activity
(10 mins)

Ask pupils why they think designing satellites to be lightweight is important

Provide pupils with a copy of **Worksheet: WORDSEARCH**



Activity
(15 mins)

Ask pupils which of the satellites types we have looked at impresses them the most and why?

Provide pupils with a copy of **Worksheet: NASA'S TEAM ARTEMIS** OR **Worksheet: A SATELLITE FOR THE FUTURE.**

Activity
(20 mins)

The RAF are working with a UK company to use imaging equipment which is installed onboard a satellite that is launched into space. The equipment works at a resolution of 1m@500km. Resolution is the ability of a device to show an image clearly and with a lot of detail. The aim of the mission is to supply full-colour video of the Earth from space. Technology has come so far in such a short space of time. It is only 54 years ago since the first colour TV show was broadcast. When SSTL launched Carbonite-2 they downloaded over 500 videos within a few weeks from all across the world. These high-resolution videos can be used to: look at port and coastal activity, analyse road, rail and river traffic, look at infrastructure, look at assets including airports, military bases even racing circuits, do 3-D mapping of different terrain to look at natural resources such as iron ore.

Zooming-in and changing from a long-shot to a close-up is fantastic. This equipment has the technological capability to zoom-in to certain areas of the video in real-time providing a good understanding of the information within these live images. Some technical drawings show parts of objects in different scales. Just like the video equipment used in the introductory video explainer.

Provide pupils with a copy of **Worksheet: SCALING-UP.**

Activity
(20 mins)

Ask pupils what the key requirements are for building a satellite
(Needs to be reliable to get there and stay up there/ability to send reliable information back to Earth/design/budget/risk/resource/staff or expertise available).

Provide pupils with a copy of **Worksheet: SATELLITES QUIZ.**

ANSWERS:
Q1: What does UKSA stand for?
United Kingdom Space Agency

Q2: What is a magnetometer?
An instrument that maps the magnetic field of a planet

Q3: What is a black hole?
A region of space having a gravitational field so intense that nothing can escape

Q4: Which of these are the three main components of satellites?
A power unit, an orientation unit and communication equipment

Q5: What is meant by deployment sequence?
The stages involved on launching and releasing a satellite into space

Q6: What does the word orbit mean?
The curved path of a celestial object or spacecraft round a star, planet, or moon

Q7: What is an orientation unit, one of the key instruments on satellites?
A compass that provides positional data from the sun and the stars

Q8: What is the International Space Station?
A big satellite that people can live in for a long time

Q9: What is a habitation module?
The main living area in a satellite

Q10: What does NASA stand for?
National Aeronautics and Space Administration

SATELLITES
TEACHER / FACILITATOR PACK
CONTEXT AND EXAMPLES

SCOTLAND AND SATELLITES

Scotland's space sector is rising faster than anywhere else in the UK, aiming to grow in value to £4 billion by 2030. Scotland has some of the highest space-related activity in Europe and Glasgow manufactures more satellites than any other city in Europe. Scotland has strong roots in satellite manufacturing, rocket manufacturing, data and ground-breaking research. And with new developments like the UK's first orbital spaceport, now is a great time for Scotland's growing space industry.

Businesses across the UK will be involved in building the service module and habitation module of the Lunar Gateway, a new space station orbiting the Moon. There will be new opportunities for UK companies and scientists to be part of NASA missions to the Moon and Mars and the UK Space Agency says these new opportunities will generate economic benefits and create high-skilled jobs.

SCAN ME

RAF PILOT HELPING TO LAUNCH SATELLITES

ROYAL AIR FORCE

Fifty years after the moon landing the Royal Air Force planned to take its first small steps into space. An RAF pilot was thrilled to be asked to launch a satellite as part of the Ministry of Defence's space programme swapping the cockpit of his RAF Typhoon jet for a heavier and slower Boeing 747. The specially adapted passenger plane had been designed to carry a rocket which can launch satellites into space. The pilot said he was "very excited" to be joining a "very cool" space industry.

SCAN ME

SATELLITES

TEACHER / FACILITATOR PACK

CONTEXT AND EXAMPLES

SATELLITE LAUNCH

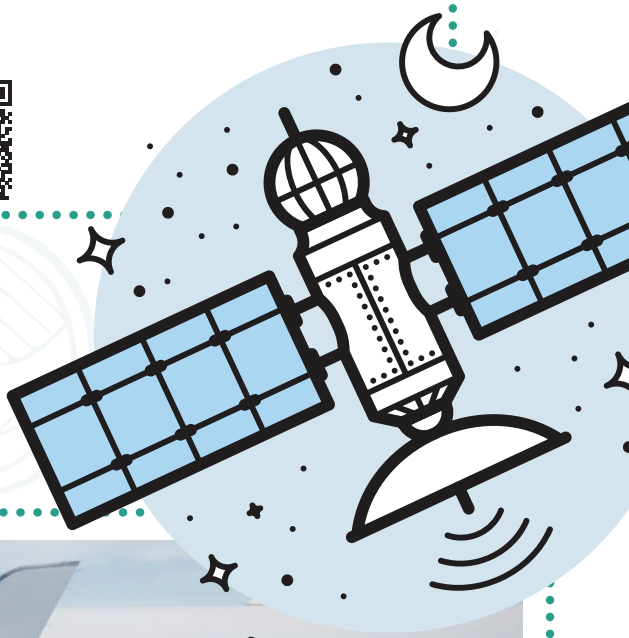
Launching and deploying a satellite comprises a number of sequences. This step-by-step video shows you from launch to deployment.

SCAN ME

HOW DO SATELLITES WORK?

There are around 5,000 satellites orbiting the Earth right now. The most obvious questions that come to mind are: Why are these satellites in totally different orbits? How does a satellite carry out all of its functions? And, what are the components inside them, which help them to accomplish all of their allotted tasks? This video provides an overview.

SCAN ME



PROJECT ARTEMIS AND THE RAF

Known as Project Artemis, this transatlantic space programme will see small satellites launched from a rocket beneath a plane's wing.

The modified plane, called Cosmic Girl, carries a rocket attachment beneath its left wing which will be fired into space once the plane reaches cruising altitude.

Team ARTEMIS will collaborate to build, launch, and operate a series of Surrey Satellite Technology-built spacecraft from the U.K., establishing a sovereign capability that complements capabilities planned by Australia, Canada, and the U.S.

SATELLITES
TEACHER / FACILITATOR PACK
CONTEXT AND EXAMPLES

SPACE ROCKETS IN SCOTLAND

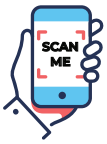
SPACE ROCKETS IN SCOTLAND!

The UK government has committed to launching a space rocket from Scotland by 2022. Work is already well underway to make that happen.

In August 2020, the Scottish Highland Council granted planning permission for a £17.5m facility in Scotland called Space Hub Sutherland. The site is expected to launch up to 12 small satellites a year. These satellites are generally used for Earth observation, including vegetation, weather, cloud cover, ice cover and so on. Much of the science to monitor and understand climate change is enabled by satellite data.

The site will create jobs for the following areas: mechanical and electrical engineering; weather monitoring; control room operations, ground services, rangers, security, fuel services, marketing, management, housekeeping and administration. There will also be posts working with launch and satellite companies.

More information on Space Hub Sutherland website.



Take a video tour of the space hub here.