



# Astro Academy: Principia

Programme overview



### UK Space Agency

The UK Space Agency is at the heart of UK efforts to explore and benefit from space. It is responsible for all strategic decisions on the UK civil space programme and provides a clear, single voice for UK space ambitions.

The Agency is responsible for ensuring that the UK retains and grows a strategic capability in the space-based systems, technologies, science and applications. It leads the UK's civil space programme in order to win sustainable economic growth, secure new scientific knowledge and provide benefits to all citizens.



### ESA

From the beginnings of the 'space age', Europe has been actively involved in spaceflight. Today it launches satellites for Earth observation, navigation, telecommunications and astronomy, sends probes to the far reaches of the Solar System, and cooperates in the human exploration of space.

Space is a key asset for Europe, providing essential information needed by decision-makers to respond to global challenges. Space provides indispensable technologies and services, and increases our understanding of our planet and the Universe. Since 1975, the European Space Agency (ESA) has been shaping the development of this space capability.

By pooling the resources of 22 Member States, ESA undertakes programmes and activities far beyond the scope of any single European country, developing the launchers, spacecraft and ground facilities needed to keep Europe at the forefront of global space activities.



### National Space Academy

Established in 2011 and led by the National Space Centre, the National Space Academy is now the UK's largest space education and skills development programme for secondary and further education. Its team includes some of the country's best science teachers, project scientists and engineers who deliver masterclasses and intensive teacher training for thousands of students and teachers across the UK every year. Internationally the Academy works extensively with the European Space Agency, the UAE Space Agency, and it also leads the UK's ongoing space education and skills development work with China.



### Astro Academy Principia

A unique education programme developed by the UK's National Space Academy for the UK Space Agency and ESA (European Space Agency), Astro Academy: Principia uses a suite of demonstrations filmed by ESA astronaut Tim Peake aboard the ISS during his six month Principia mission to explore topics from secondary physics and chemistry curricula. The programme is made up of stand-alone teaching films, downloadable video clips, downloadable files that can be used with the free-to-use dynamical analysis software programme "Tracker", written teacher guides and links to more than 30 further teaching activities.



### Principia

Tim's mission to the International Space Station, called 'Principia', used the unique environment of space to run experiments as well as try out new technologies for future human exploration missions. Tim was the first British ESA astronaut to visit the Space Station where he spent six months as part of the international crew.

## Overview

Astro Academy: Principia is an education programme developed by the UK National Space Academy programme for the UK Space Agency and ESA (European Space Agency). The Academy designed, constructed, flight-qualified and developed experimental procedures for a suite of physics and chemistry demonstration experiments that were conducted by ESA astronaut Tim Peake aboard the International Space Station (ISS) during his six-month mission in 2016.

The overall programme includes the following topics from UK physics and chemistry secondary school curricula:

- Newton's Laws
- Momentum and Kinetic Energy
- Circular Motion
- Kinetic theory of gases and molecular vibrations
- Gravity, ballistics and orbits

There are also links to more than 30 further teaching activities covering curriculum areas including:

- Conditions for life
- Temperature and rates of reaction
- Behaviour of charged particles in magnetic fields
- Kepler's Laws
- The chemistry of comets
- Einstein's theories of Special and General Relativity
- The origin and future of the Universe
- Cloud chambers and radiation
- The physics and chemistry of rockets

**Nearly 50 videos of demonstrations/experiments conducted by Tim on the ISS, including:**

- High-quality video clips of Tim conducting science demonstrations that can be used by secondary and primary students and teachers.
- High-quality video clips of selected demonstrations with dynamic analyses including synchronised displacement-time, velocity-time and acceleration-time graphs enabling discussion up to pre-University level physics and mathematics.

**Tracker analysis films and tools for students and teachers** to be able to perform their own dynamic analysis of the experiments using “Tracker” software picking whichever variables they wish to investigate and intended for use from high school up to University level. A basic Tracker Guide document is also included.

**Teacher guides** giving further details of ground-based experiments, Tim's orbital demonstrations, explanations of the fundamental concepts from physics and chemistry being covered and extra information on space applications of these concepts. Extension questions and model answers are included.

**Teaching films** - five stand-alone short teaching films cover various themes from human spaceflight which are used as contexts to explain fundamental concepts from the physics and chemistry curriculum. The films contain simple experiments which students can conduct themselves, coupled with orbital demonstrations conducted by Tim which yield different results in the microgravity environment of the ISS. In addition, the films also include further applications of these contexts to other space topics.

**Further teaching resources** – links to more than 30 further teaching activities developed and filmed by the National Space Academy for ESA and STFC (Science and Technology Facilities Council) and hosted online.

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<http://nationalspaceacademy.org/>

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[www.esa.int](http://www.esa.int)

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[www.hslu.ch/en/lucerne-school-of-engineering-architecture/research/kompetenzzentren/aerospace-biomedical-science-and-technology/biotesc/](http://www.hslu.ch/en/lucerne-school-of-engineering-architecture/research/kompetenzzentren/aerospace-biomedical-science-and-technology/biotesc/)

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