

Leading practice in space education

Successful approaches by specialist schools



Overview

The aim of the Government's Science, Technology, Engineering and Mathematics (STEM) programme is to ensure Britain's future success as a major centre for science, engineering and innovation. Specialist science, technology, engineering and maths & computing colleges help to drive this programme by becoming centres of excellence in STEM subjects. They develop learning and teaching approaches and opportunities in STEM subjects that motivate and inspire learners. They promote participation and achievement in STEM including in partner schools and the wider community.

This report describes varied examples of the effective use of space in the curriculum to achieve these aims. Contributing schools were all part of the Leading Space Education Programme that was funded by the Science and Technology Facilities Council (STFC). A network of 30 specialist schools was established and supported by the Specialist Schools and Academies Trust (SSAT) to develop and embed high-quality, space-themed educational practice.

Each section gives a flavour of how space can enhance practice in schools through curriculum innovation, extended-curriculum activities, network activities and STEM in the community. The report finishes with some tips and guidance to help other schools to implement space curriculum approaches.



Why space?

Space education is a versatile and motivating context for curriculum and skills delivery with great potential for developing and enhancing specialism in schools.

As well as being a subject which consistently engages students, there are economic and social reasons for the emphasis of space in the STEM curriculum in schools. The space industry in the UK is a major economic and technological success but the skills base needs to grow at all levels if the country is to maintain this high-tech component of our future economy. There is a huge range of STEM career opportunities in this relatively new and burgeoning field.

Space raising the profile and impact of specialism

Schools report that space can act as a mechanism to stimulate teachers and support staff and revitalise specialism. Many are finding it effective in promoting ethos and engaging partner schools and the wider community. Focusing developments around a theme such as space creates an opportunity to establish and promote the specialist school as a centre of excellence.

Space has revitalised specialism in the school. Being a leading practice space school is a badge we can wear with honour and enables us to maximise the impact of specialism. Space has:

- opened doorways for us and given us opportunities to establish and develop partnerships with other schools, business and higher education
- led to staff development through space enrichment and enhancement events as we work with others in, across and beyond our own school
- provided contexts to sustain delivery of the curriculum in ways which enthuse the students and develop their personal, learning and thinking skills
- developed community engagement, particularly with parents
- helped us with redesignation as a specialist school
- provided us with opportunities to be involved in other STEM priority activities such as the Girls in Physics programme and a rocket design competition in collaboration with the sixth form college.

High Tunstall College of Science, Hartlepool. Specialism: science

St Michael's High School is a joint faith school in an area of high deprivation and challenge. Staff worked hard and successfully to use science specialist status to promote space. Modern media have been used to provide students with access to space learning resources. For example, over 100 hours of space videos were prepared for students to view on their MP4 players and astronomy club members gave talks which were made into podcasts and uploaded to YouTube. Topics included the astronomy club activities, things to watch out for in the night sky and forthcoming events. Direct access to these materials has raised motivation and aspirations; increasing numbers of students are opting for triple science. The school has also had a high profile in the local press with articles on the astronomy club and space activities.

St Michael's Catholic & Church of England High School, Barnsley. Specialism: science

Space enhancing the delivery of the science curriculum

Several schools are exploring using space as a context for the wider science curriculum to enliven learning. Space curriculum topics, such as 'Earth in space', primarily focus on the structure of the solar system, the physics of gravity and the history of scientists such as Copernicus. The existing emphasis is less often on modern space exploration and present day changes in the scientific view of the universe. Schools have taken a much broader view than this. They are using some of the huge amount of visual material and data from space probes to bring scientific issues and ideas right up-to-date. The place of space in the science curriculum has also been extended. Schools are developing complete units, or even a whole year's work, around space themes.

The advent of greater flexibility in the key stage 3 curriculum coincided with this initiative so Shoeburyness High School rewrote the year 8 course with a space theme. All year 8 students now follow our course consisting of five modules:

- The universe – The solar system, stars and galaxies.
- Humans in space – Cells, reproduction and inheritance.
- Space travel – Motion, light and sound, materials.
- Planetary chemistry – Elements and compounds, reactions.
- Astrobiology – Food chains, photosynthesis, natural selection.

All the required aspects of key stage 3 science are covered, but through a natural fit with these space themes. Year 8 was sometimes seen as a 'gap year' but students now graduate with a specialism in one module awarded at a whole school graduation. This was complemented by a rebranding of the science department as a Space Academy and a laboratory designated as 'mission control'.

Shoeburyness High School, Southend. Specialism: technology

Several participating schools used space very effectively to extend or enhance the curriculum at key stage 4. St John's School rejuvenated its previous enthusiasm for astronomy. It produced an astronomy module for BTEC Science and shared this with partner schools. GCSE Astronomy was reintroduced and resources for this course lodged on its virtual learning environment. Belvidere School used space-related contexts to enhance GCSE science topics including the electromagnetic spectrum and forces.

St John's School, Marlborough. Specialisms: technology, languages
Belvidere School, Shropshire. Specialisms: technology, training school



Space as a context for STEM subjects

Several schools are using the space theme as a great means of encouraging collaboration between STEM subjects so that it enriches and gives purpose to each. Space is an efficient way to reinforce skills across STEM subjects and contextualise learning.

In many cases, local activities require subject departments to cover complementary topics such as the mathematics and science of rockets. Students plan, design, build and test their rockets, using a variety of skills and knowledge used in a competitive context in design and technology lessons.

The Robert Smyth School established a group to promote STEM across the curriculum using space as a theme. For example, in mathematics, distance-time graphs for rockets were used, whilst technology and science provided 'hands-on' experience and participation in a national rocket design and build competition. Involvement in space-related activities is now developing rapidly through the school's own Space Education Centre, supported strongly by the National Space Centre. They are already used extensively by STEM subjects but also by other curriculum areas and partner schools:

'Having a Space Education Centre gives our work a real focus – it's just one of our teaching labs decked out with fabulous posters and pictures but it makes a great venue for all sorts of events.'

Robert Smyth School, Leicestershire. Specialism: technology

Students at St Peter's undertook a space competition and the winners then went on to work with Team Starchaser on rocket design and construction. This was run as a STEM event and leaders in these departments are now collaborating on the production of curriculum materials for use in the school and a space themed transition project for years 6 and 7. This has resulted in much improved attitudes and response to STEM subjects amongst students and teachers alike.

St Peter's Catholic School, Solihull. Specialism: science



Space as an inspirational whole school theme

Space education provides ample opportunities to develop personal, learning and thinking skills, particularly the skills of independent enquiry and creative thinking.

The motivational benefits of space themes can be spread wider than just STEM subjects. Space has inspired humankind for thousands of years so literature, poetry, art, geography and history are natural partners in this theme, while the PE department might support astronauts in training.

At Hadley Learning Community, a themed key stage 3 curriculum has been introduced. 'Earth and beyond' was developed as one of the year 7 themes with all subject areas contributing. Materials are available to students, staff and parents via the school's online learning environment. Wider access is now planned so partner schools can access materials, use them and provide feedback. These developments are reported to have improved teaching and learning through the focus on preparation of a themed curriculum with space playing a major part.

Hadley Learning Community, Telford and Wrekin. Specialism: engineering

The Holy Cross School developed online links with a school in Taiwan through the Science Through Arts project (STAR). This link was used to share curriculum resources for a cross-curricular year 8 project – 'Space science across the curriculum'. Activities included: painting and drawing the Moon, Mars and other planets based on scientific data, dance involving 'weightless' movements, music composition on a space theme, ICT and English writing and illustrating space stories. Naturally, STEM subjects were involved in a variety of space activities.

The Holy Cross School, Kingston-on-Thames. Specialisms: science, applied learning

The curriculum for key stage 3 students at Kennet School has been redeveloped as a cross-curriculum space academy. For example, science teachers have worked with colleagues in textiles, geography and technology to develop topics on the design of Moon bases, use of satellite to monitor land use, design and testing of remote control devices and the investigation of lightweight fabrics under space conditions. The first students will graduate in 2010 and the programme will continue to develop and extend for the foreseeable future.

Kennet School, West Berkshire. Specialisms: technology, modern languages, arts



Space as a link to higher education, the space industry and careers

Direct links with those already working in research or in the space industry make STEM subjects seem much more relevant and immediate to students. Schools participating in the project are liaising with higher education and developing relevant industry links with an aim to maintain partnerships that have an impact on students' perceptions of careers in the space industry.

Space is far more than astronomy and the space industry is more than putting rockets into space. Space research and industry activity includes developing instrumentation, astrobiology, telecommunications and environmental monitoring through earth observation. These all require a wide range of employee skills and qualifications covering the full spectrum of students' capabilities.

Ashton Community Science College developed strong links with the local University of Central Lancashire (UCLAN). Students were the first to attend sessions at the UCLAN's observatory and staff also helped select an outreach teacher who now works closely with schools in the area on a range of topics including space. As a result: 'Science is no longer just something done in the lab, there is a real world out there which students can relate to. There is no doubt that involvement with the university has put science in a more positive light.'

Ashton Community Science College, Lancashire. Specialism: science

Students at Kennet School have been involved in a current British space mission called MoonLite (Moon Lightweight Interior and Telecoms Experiment). Once deployed, small missile-like probes called penetrators will embed instruments in the lunar surface and these can then be used to explore the Moon's subsurface and measure 'moonquakes'. Pupils from the school have been using teamwork and problem solving skills to help develop educational instructions for a MoonLite model in partnership with Surrey Satellite Technology. This activity is part of a growing relationship between the school and the UK space industry.

Kennet School. West Berkshire. Specialisms: technology, languages, arts



Space as an opportunity for student leadership

Several of the participating schools are introducing 'space ambassador' schemes. Students are given opportunities to communicate their knowledge and enthusiasm to others, usually primary children or the wider community. This is of mutual benefit: students gain communication skills and confidence while others encounter new ideas expressed in straightforward student language.

Schools have found that space is a topic that engages students of both sexes and of all abilities. This makes it an ideal theme for developing students' ability to communicate with peers, younger students and adults. However, although the topic has been shown to be inherently interesting, this should never be taken for granted; it is important to ask students what activities appeal and listen to their suggestions about how to tap into this natural enthusiasm. Schools asked students directly what they thought of curriculum and extra-curricular activities as part of self-evaluation and received positive feedback.

The establishment of our space ambassadors has had a real impact on uptake for the triple science GCSE course. A third of the year 9 space ambassadors are now on the triple science course (previously single figures). This indicates how the Leading Space Education Programme has enthused our students.

Norham Community College, North Tyneside. Specialism: technology

Shoeburyness High School introduced a programme of Primary Space Days with year 12 and 13 students acting as space trainers. They were fully kitted out to look the part and worked with small groups on a wide range of activities which contributed to the theme of a Mars landing. For example, the trainers demonstrated how model Mars lander vehicles could be programmed to follow a chosen route and guided pupils' problem solving project: 'how can we provide the best soft landing for an egg?'. Primary pupils from years 2 to 6 were involved and without the sixth form students' help, the day could not have taken place as planned. Students also developed their communication skills and ability to explain scientific ideas simply but accurately.

Shoeburyness High School, Southend. Specialism: technology



Space strengthening partnerships with primary and secondary schools

Space can provide a context for links with other schools and lead to sustained partnerships. There are few space experts in schools; most teachers rely on the knowledge of others. The development and sharing of expertise throughout local communities of schools is a key aspect of specialism. Schools have a wide variety of ways of doing this including joint visits, shared space days, training events, pooling of resource materials and competitions.

Stewards School entered into partnerships with 18 primary and secondary partners which included some new partnerships. A wide range of space-related activities was initiated including:

- a space lecture for key stage 2 children and their parents
- a space story writing competition for key stage 1 and 2
- an invitation to Stewards Space Spectacular
- professional development for teachers on teaching space themes
- Spring Moon Watch.

Partner schools were also invited to join in other activities including a series of space lectures and competitions.

Stewards School, Essex. Specialism: science

Thomas Hardy School has widely spread partner middle and upper schools. However, space was rapidly established as an effective and exciting partnership theme. A competition was held between the four middle school partners, based on the structure of planet earth and how earthquakes occur. Pupils built earthquake-proof structures and tested them at the University of Bristol. Other activities included rocketry, the Virgin Galactic competition and visits to the Fleet Air Arm Museum and big bang science fair. The impact on partner school staff and pupils was very positive: all science staff were very motivated by the competition, the pupils produced outstanding portfolios, beyond our expectation. The evidence was collected and will be used as exemplar material.

The Thomas Hardy School, Dorset. Specialisms: science, SEN, humanities



Space themes engaging the wider community

Space provides an excellent theme for work with local communities. Interesting talks or activity days with a space theme prove effective in getting the wider community interested. Several schools host a series of astronomy talks for adults, initially for interest, but in some cases these are so successful that GCSE Astronomy classes are run for parents and teachers.

Space has been one of the first activities that has really got parents interested and attending specialism events. We now attract a group of students and their parents who are fascinated by this area of science.

Woodkirk High School, Leeds. Specialism: science

Sackville School developed awareness of STEM in the school and wider community through using space as an inspirational hook. The press and media were used to inform about activities and involve the community. The local newspaper was invited to attend and report on activities and a website was designed which could be accessed via the school's main webpage. The website acts as a resource bank, contact point and means of celebrating success; it has received over 1,000 hits per month. As a result of this publicity, ex-students, family and friends have volunteered to become involved in space activities. More students are engaged in extra-curricular activities and careers in space engineering are firmly on the map.

Sackville School, West Sussex. Specialism: engineering

Over 200 parents attended each of three sessions run by Simon Langton School during the first year of the project. The 'Langton Guide to the Universe' continues to be well supported by parents and now a wider audience. These lectures and other activities are advertised on the Langton Star Centre website which has also been used to help local Bridge Brownies obtain their stargazer badges. Scouts and Guides in the area are also working towards astronomy badges with help from the school.

Simon Langton Grammar School for Boys, Kent. Specialism: science



Launching a space programme in your school – some suggestions for getting started

Leadership and management are crucial to the successful introduction of any school activity and vital for long term impact.

Participating schools all have their own stories to tell and all learnt lessons from which others can benefit:

- Support and encouragement of senior staff is key.
- Raise the profile of space through celebrating and recognising achievements and developments from staff and students in briefing, assemblies and displays.
- Develop a core small group of space enthusiasts among the staff – these may not necessarily be qualified or experienced in space.
- Involve as many departments as possible.
- Allocate teacher time for planning and preparation, particularly when this involves cross-curricular work.
- Start with manageable projects which build on current opportunities, such as planned whole school enrichment days or development of a virtual learning environment.
- Monitor and evaluate to identify the successful impact and value of space developments.
- Make use of other funding sources such as the STFC small grants or Royal Society Partnership Grant schemes.

For curriculum delivery developments:

- Use student voice and departmental evaluation to identify topics that need revitalising.
- Use planned changes – such as new specifications or curriculum redesign – as opportunities to bring in space.
- Consider models of cross-STEM working and skills mapping.
- Be inventive and creative – new contexts provide new interest.

Helpful links include:

- The SSAT website: www.ssatrust.org.uk including STEM lead practitioners, Leading Practice in STEM and STEM webpages.
- ESA education resources: www.esa.int/education
- National Space Centre: www.spacecentre.co.uk

For enrichment and enhancement:

- Make good use of existing schemes and business or university links.
- Plan for longer term impact with pre and post event activities.
- Make use of students to support, drive or evaluate developments.
- Consider organising events for your network of schools as you may get prioritised for outreach.

Helpful links include:

- STEM leaders qualification: www.personalcapabilities.co.uk/slq
- STEM clubs support: www.stemclubs.net
- STEM directories: www.stemdirectories.org.uk
- STEM Ambassadors and STEM points: www.stemnet.org.uk



For community engagement and careers:

- Use an active local network to build on.
- Develop new school networks around a particular focus and purpose, such as working towards an inter-school competition or event.
- Establish what the need is among partner primary, secondary and other partners.
- Establish true partnerships. Offer something back, such as developing an educational outreach programme with a space industry or university department.
- Thread space and other STEM careers into curriculum delivery, enrichment and enhancement as well as direct HEI or business activities.



Helpful links include:

- Space directories: www.ukspacedirectory.com
- SSAT HE team: www.ssatrust.org.uk/community/highereducation
- STEM careers: www.futuremorph.org or <http://sciencesowhat.direct.gov.uk>

Involving a whole school in space-related activities is not always easy but that is just what Alexandra Park School achieved. With the active support of the headteacher, an inset day was devoted to space-related work with the aim of getting all subject areas to prepare outstanding lessons linked to this theme. To start with, two senior HE lecturers, one from University College London and one from Cardiff, enthused and informed staff about space science. Teachers then met to produce schemes of work and lessons on relevant themes. For example, the art department posed the question 'what would be found in the fossil record of today if a meteor destroyed the earth as we know it?' This led to artwork involving such things as fossilised iPods. Teachers were enthusiastic, produced some high quality lesson plans and went on to use these to tap into students' natural interest in space.

Alexandra Park School, Haringey. Specialisms: science, maths & computing



Further information

For further information about SSAT programmes to promote STEM, please contact:

Chris Overall, National STEM Programme Coordinator.

Email: stemenquiries@ssatrust.org.uk

Other helpful guidance and resources will be found at:

European Space agency education resource office UK: www.esero.org.uk

UK space agency: www.ukspaceagency.bis.gov.uk

STEM agenda: www.dcsf.gov.uk/stem

More detailed case studies and exemplar material are available at:

www.ssatrust.org.uk/stem



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