Using space as a context for teaching science

Mark Smith

ABSTRACT This article describes how the Science Department at Shoeburyness High School in Essex introduced a space-themed year 8 (ages 12–13) science course to increase student engagement and motivation. As well as discussing the rationale for such curriculum change, it describes the processes of planning and resourcing the course, and the barriers that need to be overcome to make such a significant undertaking successful.

In my experience, space has always been an area of science where a vast majority of students show an enthusiasm of which most other school subjects can only dream. The incomprehensibility of the scales, the sheer brilliance of the images of objects millions (or billions) of miles away and the almost fairy-tale nature of our 50 years of space exploration – these all contribute to the 'wow factor' that students have when we teach about space.

And yet, in most schools, teaching about space or using space as a context is a tiny part of the curriculum, perhaps limited to a short topic about the solar system in key stage 3 (ages 11–14) and a few weeks of teaching in GCSE Physics or Science. At Shoeburyness High School, we decided to take advantage of the enthusiasm that students show for space by planning a space-themed Science curriculum.

The Leading Space Education Programme

In the summer of 2008, the opportunity arose to become part of the Leading Space Education Programme (LSEP), which was developed by the Specialist Schools and Academies Trust (SSAT) and funded by the Science and Technology Facilities Council (STFC). Thirty schools from across the UK, including Shoeburyness High School, were selected to take part in LSEP at launch.

The project was launched during a time of change for secondary education: while the leaders of the LSEP projects from each school were meeting at our inaugural conference in October 2008 to discuss how the project would proceed, the then schools minister Ed Balls announced that England's key stage 3 National Curriculum tests (often known as 'SATs') were to be abolished with immediate effect. For Shoeburyness High School Science Department, this gave us an additional impetus to drive forward significant change to our Science curriculum.

Planning a space-themed curriculum

Making the decision to implement a significant change to the Science curriculum as a result of joining LSEP was very straightforward. The key factors in deciding on the change were:

- having a senior leadership team that has always encouraged curriculum innovation as a way to increase student engagement and achievement;
- implementation of a new school policy to begin key stage 4 studies in year 9 (ages 13–14) in core subjects;
- working with a team of science teachers who are willing to engage in all aspects of curriculum change, from planning and preparing resources to teaching in a new, context-driven way.

We had already developed a new year 7 (ages 11–12) Science course themed around science in everyday life, relating specifically to the local area; examples of themes for our year 7 modules include 'Science at Home' (simple chemistry and materials), 'Adventure Island' (the local theme park – forces and nutrition) and 'The Beach' (adaptation, feeding relationships, etc.). We had been considering our options for a theme for our

year 8 (ages 12–13) course, and space became the obvious choice.

We set about designing our 'Space Academy' course with a blank canvas approach. We knew which areas of science we needed to cover, so the whole science team worked together to decide how we could use space-related contexts to teach the full range of science topics. Our final choices for module titles and outline content are shown in Table 1.

When writing the new modules, our highest priority was to develop contexts and resources that would inspire as many students as possible. We were also keen that the Space Academy modules should reflect the interdisciplinary nature of the space science industry. Various models for the structure of the course were considered before we settled on the final choices. Each module has a theme that runs throughout: the scene is set in the first lesson and the theme evolves as the module develops.

Module 1 – The Universe

Although the content base of this module is that of a 'traditional' space module, the Space Academy theme is one of human exploration. The structure of the solar system is studied in a historical context, evaluating geocentric models. The module then looks further afield, expanding students' thinking about space by considering the nature of stars, galaxies and the universe as a whole.

Module 2 – Human Survival

At first, it seemed that biology topics would provide the biggest challenge in developing suitable teaching contexts. Inspiration came as a result of considering the many Hollywood films that suggest that the Earth may be in danger of becoming uninhabitable, such as *Deep Impact*, *2012* and even *Wall-E*.

The module emphasises the challenges that humanity will face in permanently leaving Earth to find a new home elsewhere in the galaxy, and proposes a 10 000 year journey. Students are encouraged to consider the skills and knowledge that the chosen passengers would need to have, including the biological knowledge needed to maintain a healthy population. Key knowledge taught includes cells, organs, organ systems, reproduction, health and disease.

Module 3 – Space Travel

The context of space travel was an obvious choice for a topic on forces. The Science team decided on a final context which includes a mini-project on spacecraft design that looks at the properties of materials and uses a series of practical

Figure 1 The Shoeburyness High School Space Academy logo, designed by Space Club members, is used on all teaching resources related to the Space Academy course

Table 1 Modules included in the year 8 Space Academy course

Module title	Science content
The Universe	Earth in space
	The solar system and beyond
Human Survival	Cells and organs
	Reproduction
	Health and disease
Space Travel	Forces
	Light and sound
	Properties of materials
Planetary Chemistry	Elements, mixtures and compounds
	Chemical reactions
	The periodic table
Astrobiology	Photosynthesis and respiration
	Ecosystems and interdependence
	Adaptation and evolution
Reach for the Stars!	Why study science?
	Careers in the space industry

investigations to establish the best materials for spacecraft visiting hostile environments.

Communication is used as a context to learn about the properties of light and sound and the challenges that arise when communicating in space. Rocket motion and orbits are used to encourage thinking about forces.

Module 4 – Planetary Chemistry

A grand tour of the solar system runs through this predominantly chemistry-themed module. Starting at Earth (learning about metals and non-metals), students learn about Martian rocks (atoms and elements), the atmosphere of Venus (elements and compounds), Europa (reactions with acids) and Ganymede (reactivity of metals), and other planets and moons are used to study more complex chemistry.

Module 5 – Astrobiology

Does alien life exist? This is a question that fascinates many children and adults, so it is only sensible to use this interest to stimulate learning in science lessons.

While studying adaptation and simple ideas about evolution, students consider how alien life forms may be adapted to life on planets different to our own. Like real astrobiologists, we study extremophiles here on planet Earth to inform discussion about how extraterrestrial life may have adapted.

The module then contemplates the challenges for creating permanent human settlements on Mars. Students make sealed mini-biodomes, while studying photosynthesis and respiration as key life processes, and consider ideas about ecosystems and interdependence.

Module 6 – Reach for the Stars!

After module 5, students complete their end of key stage 3 assessments. To end year 8, students have a three-week module looking at the importance of science and the careers that are available in the UK space industry. According to the UK Space Agency, the industry directly employs 25 000 people (and indirectly supports a further 60 000 jobs) and contributes £7.5 billion to the UK economy (see *Websites*), yet few people are aware of the success of the UK in this field.

A careers-focused module allows students to investigate the work of a range of people in the space industry, including engineers, physicists, managers, designers and graphic artists. They find out about these careers using a variety of media and resources that allow them to see that careers in science are varied and interesting.

Figure 2 The entrance to the Science Department, rebranded as 'Shoeburyness Space Academy' with space-related canvases

Figure 3 The author teaching cells in the topic 'Human Survival', a biology module taught using the context of human space exploration

Successes achieved through the year 8 Space Academy course

Since the introduction of our year 8 Space Academy course in September 2009, a number of significant measurable successes have been recorded. Attainment of pupils at the end of year 8 (which is the end of our key stage 3 course) has increased significantly since the introduction of the course. This is with cohorts of near-identical prior attainment (measured through key stage 2 levels and cognitive abilities tests (CATs)), using

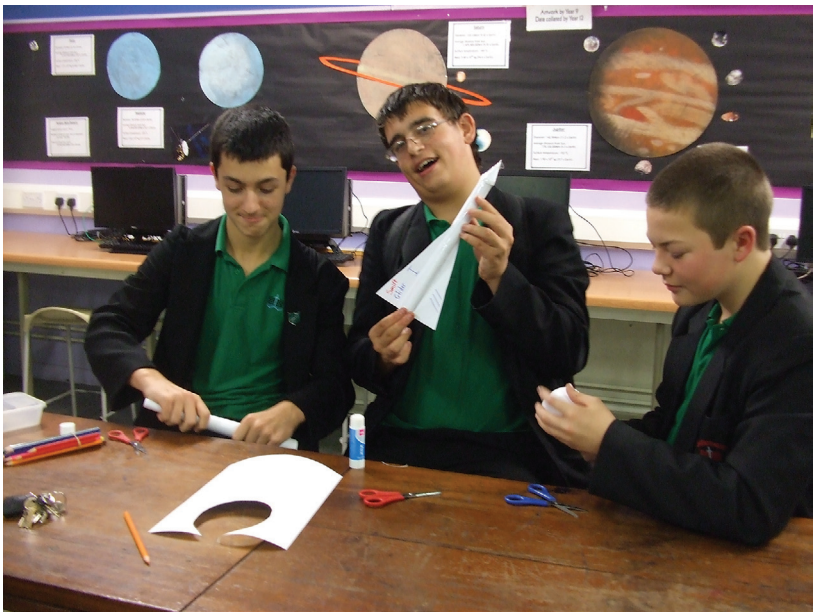

Figure 4 Students building air rockets during a topic on 'Space Travel'

identical assessments. A summary of year-on-year key stage 3 data is shown in Table 2.

The motivation of students, and hence behaviour, has improved significantly. This is measurable as a 50% drop in the number of recorded behavioural incidents over 2 years.

Teachers in our Science Department are very proud of 'our course' and teacher motivation is high, which is an extremely important factor in raising pupil achievement.

It should be pointed out that none of these successes can be attributed solely to the introduction of the Space Academy course; the number of other variables involved in a school situation is of course significant. However, I do believe that Space Academy is the greatest contributory factor.

Table 2 Key stage 3 end-of-year pupil attainment before and after the introduction of the Space Academy course

Year	Course	Percentage of pupils reaching…	
		Level 5+	Level 6+
2009	Traditional	72.5%	32.1%
2010	Space Academy	80.6%	33.1%
2011	Space Academy	87.6%	47.2%

Tips for success

Planning a course of your own from a blank sheet of paper is not easy, and we have had to overcome a number of obstacles along the way. If a project like this is to be successful, there are a number of things to take into consideration.

- Begin planning your course as early as possible – we started planning in the autumn term of 2008 to be ready for teaching in September 2009, which gave us plenty of time to check our curriculum coverage, to prepare and trial resources, to plan for assessments and to share schemes of work with the teaching team, ensuring all teachers were ready to teach in the new year.
- Ensure that your school's senior leadership team is fully aware of what you plan to do and of your reasons for wanting to innovate in this way. You will need their support if you are to be successful, so emphasise the potential benefits of a personalised course.
- Make sure that you are able to 'sell' a new course to your science teaching team – it will not be successful without the full support of the teachers who will need to deliver the lessons. If you anticipate resistance to change from some members of your team, try to engage those teachers who will be supportive early on in the process. All teachers were expected to contribute

Figure 5 Year 8 Space Academy students building Mars landers

to preparing schemes of work and resources, and this was made easier with consultation early in the planning process.

- Engage your technician team in discussions about resourcing any new course at the planning stage – you will need to consider the cost of any new resources and the impact this may have on the department.
- If possible, try to find other schools that are prepared to share resources to save time and effort with planning. Many of our resources, including schemes of work, are available to download from our Space Academy website (see *Websites*).
- Use the many resources that are available on the internet from organisations such as ESERO-UK (the UK branch of the European Space Education Resource Office, ESERO), SSAT (now also known as The Schools Network) and the major space agencies.

With careful planning, a personalised space-themed course can have a real impact on Science teaching, improving student motivation and raising achievement.

Websites

ESERO-UK: www.esero.org.uk.
Leading Space Education Programme (LSEP): www.ssatrust.org.uk/subjects/science/pages/leadingspaceeducation.aspx.
Science and Technology Facilities Council: www.stfc.ac.uk.
Shoeburyness High School Science Department: www.shoeburynesshigh.co.uk/index.php?cat=1&page=22&sub=38.
Shoeburyness High School Space Academy: sites.google.com/site/shoeburynessspaceacademy/home.
UK Space Agency: www.bis.gov.uk/ukspaceagency/who-we-are/strategy.

Mark Smith is head of science at Shoeburyness High School in Southend-on-Sea, Essex, and prepared the school's successful bid to become a part of the Leading Space Education Programme (LSEP). Email: marksmith@shoeburyness.southend.sch.uk