

# UK Space Agency Education, Skills and Outreach Strategy

*Using space to inspire learning. Helping to build a skilled workforce.*

## 1 Executive Summary

The main objective of this strategy is to ensure that as many young people as possible are inspired by space to study, and keep studying, STEM subjects to tertiary level ensuring a skilled and enthusiastic workforce for high tech industries (including space) in the future.

It addresses two distinct, though related, issues:

1. Space has demonstrated a remarkable power to inspire widespread interest in science, technology, engineering and mathematics (STEM) and provides exciting contexts for the teaching of a range of subjects
2. Growth of the space sector is hampered by the scarcity of UK graduates and technicians with relevant skills and qualifications.

The first of these presents an opportunity to use *space for education* and the second is a problem that can be addressed by using *education for space*.

These two equally important aspects are intimately related since harnessing space to improve the take-up of STEM subjects for the benefit of the UK economy will have corresponding benefits for the space sector by increasing the potential pool of graduates and technicians.

The main features of this strategy are to:

- Understand and address the skills needs of the UK space industry
- Improve the provision of advice on space-related careers
- Encourage and support the use of space as an inspiring context for learning across all age groups
- Develop wider outreach programmes to improve awareness of and engagement with the UK's space programme.

## 2 Background

The UK Space Agency has four inter-related responsibilities. These are to:

- lead UK civil space policy within Government, providing informed and impartial advice to decision-makers and ensuring the UK's views are influential in the international space policy environment
- build a stronger national space capability encompassing scientific and industrial centres of excellence, national space facilities, and a growing, skilled UK space workforce
- deliver a range of national and international space programmes in cooperation with industry and academia; and
- regulate UK civil space activities to ensure compliance with international treaty responsibilities.

The Agency works to deliver the *UK Civil Space Strategy 2012-2016*<sup>1</sup>. The primary goal of the Strategy is to foster the growth of the space sector and maximize the benefit of space activities for science, commerce, government and society. The central goal to create a £40 billion sector in the UK by 2030 is to be achieved via six growth pathways:

- Growth through New Opportunities
- Growth from Export
- Innovation Supporting Growth
- Science to Underpin Growth
- Education for Growth
- Growth through Smarter Government

In addition, the industry-led *Space Innovation and Growth Strategy*<sup>2</sup> and its successor, the *Space Growth Action Plan*<sup>3</sup> set out various recommendations concerning education and skills in the space sector. In particular, the Government accepted<sup>4</sup> Action 5.7 “to establish a national space skills ‘point of contact’ to support SMEs in finding training in business and specialist skills that their staff need to succeed and grow the business by supplying ‘one stop’ information about UK-based training providers.” This point of contact has been appointed and this document has been updated to reflect the increased focus on skills. Action 5.8 called for the Agency “to provide financial support for a cross-disciplinary Space Doctoral Training Centre that will support PhD students that are moving into the space sector to build relevant specialist and business skills that are needed in both the upstream and downstream space sectors.” While the Government did not commit to provide this funding, it did agree to consult with the Research Councils on the possibility of setting up a Space CDT.

While the UK Space Agency has responsibility for all strategic decisions on the UK civil space programme, there are areas of overlap with other parts of government. On education issues it works closely with partners in the Department for Education (DfE, responsible for schools) and with the Department for Business, Innovation and Skills (BIS, responsible for Further and Higher Education as well as Science in Society). It also works with the Science and Technology Facilities Council (STFC, which has a Science in Society programme that encompasses space science and astronomy outreach), the Natural Environment Research Council (NERC) and the European Space Agency (ESA, of which the UK is a member state and which has a large education programme).

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<sup>1</sup> *UK Civil Space Strategy 2012-2016* (<https://www.gov.uk/government/publications/civil-space-strategy-2012-to-2016>)

<sup>2</sup> *UK Space Innovation and Growth Strategy*, February 2010

<sup>3</sup> *Space Innovation and Growth Strategy 2014-2030: Space Growth Action Plan*, November 2013

<sup>4</sup> *Government Response to the UK Space Innovation and Growth Strategy 2014-2030: Space Growth Action Plan*, April 2014

In addition, the key delivery partner for formal education is the European Space Education Resource Office (ESERO-UK), funded mainly by ESA and DfE and set up within the National STEM Centre with a remit to use space to enhance and support STEM teaching and learning in the UK.

Advice on space education policy is provided by the Space Education and Skills Working Group which includes representatives of DfE, BIS, STFC, NERC and ESERO-UK.

### 3 Space for education

The ASPIRES<sup>5</sup> project shows that even though children enjoy science at school they do not see it as “for them.” They also do not recognise the wide variety of opportunities that studying STEM subjects at school and in Higher Education can open up. This means that take-up of STEM subjects is not as high as it could be and there is widespread demand from industry for more young people with STEM skills. It is also the case that fewer girls progress to A Level physics than boys<sup>6</sup>, even when they are equally able, thus limiting their future choices.

Several reviews<sup>7</sup> and much anecdotal evidence demonstrate that few subjects have as much impact as space to inspire interest in the young. For example, the Science Museum reports that the Space Gallery is the most visited part of the museum and the UK’s new involvement in human spaceflight has resulted in a large increase in uptake of UK Space Agency education materials by schools.

The *UK Space Strategy* states that the Agency will “work with space education and advocacy groups to tell the exciting story of the UK space programme and use it as a tool to encourage children to take up and excel at STEM subjects.”

Space provides a context to support education across all age groups in both technical and non-technical subjects. **Thus the UK Space Agency education strategy should maximise the benefit and impact of space in education in meeting the needs of the education system** (taking account of regional variations as appropriate).

### 4 Education for space

In 2012/13 the UK space sector employed 34,300 people and had an annual turnover of £11.3bn.<sup>8</sup> It supports a total of about 106,000 workers. It is one of the most highly skilled sectors of the economy: 57% of workers have at least a first degree, 17% of employees instead hold vocational higher educational qualifications (i.e. a Higher National Certificate (HNC) or Higher National Diploma (HND)), and the remaining 26% have other qualifications. The sector has been growing despite the difficult economic conditions (7.3% p.a. over the two years between 2011 and 2013) and is expected to grow to £19bn by 2020, and support an additional 100,000 jobs by 2030.<sup>3</sup>

Growth will be driven by the space industry’s unique capacity to help address the global threat of climate change, pressure on natural resources, a growing world population and violent conflict. As explained in the *UK Civil Space Strategy 2012-16*, ‘an expanding space sector needs a supply of graduates and technicians with appropriate skills. The Agency has a role to ensure that universities and colleges provide appropriate skills to meet the space sector’s specific requirements.’

<sup>5</sup> *ASPIRES: Young people’s science and career aspirations, age 10-14*, King’s College London, December 2013

<sup>6</sup> *It’s Different for Girls*, Institute of Physics, November 2012

<sup>7</sup> *The Education and Skills Case for Space*, Spencer and Hulbert, June 2006

<sup>8</sup> *The Size and Health of the UK Space Industry*, October 2014, UK Space Agency

In order to address this need, the UK Civil Space Strategy states that the Agency ‘will work with the Department for Education, further and higher education authorities, industry, education organisations and career advisors to deliver the skilled staff that industry needs for growth and promote careers in the space industry.’

A report<sup>9</sup> by Reading University in 2012 investigated the ‘skills gap’ between the needs of the space sector and the capabilities of university graduates. This report identified problems with generic skills such as computing and the interpretation of data, and confirmed that many UK companies recruit from overseas since they get too few suitable applications from the UK.

To meet overall government objectives, barriers to growth of the space sector must be overcome. **Thus in order to counter the space industry’s difficulties in securing sufficient, appropriately educated staff the UK Space Agency education strategy should aim to increase the numbers and improve the quality of individuals entering the workforce.**

## 5 Objectives

The objective of this strategy is to ensure that as many young people as possible are inspired by space so that they will study, and keep studying, STEM subjects to tertiary level ensuring a skilled and enthusiastic workforce for high tech industries (including space) in the future.

The headline recommendations in the Space Growth Action Plan will only be achieved through strong collaboration between the UK Space Agency and its partners in government, industry and elsewhere. The growth in overall workforce demanded by the sector’s growth objectives is mirrored in other high tech sectors and therefore it is imperative that the sector as a whole positions itself as the career destination of choice for the brightest and best STEM students. Many employers know that when challenged they can source skills from outside the EU, however it behoves the UK community to encourage home-grown talent to provide the enthusiastic work force of the future.

In order to deliver these aims the UK Space Agency will:

- Continue to review and monitor the skills needed by the UK space industry and help develop strategies to address these needs, both through nurturing the development of skills and through attracting skilled staff into the sector.
- Work with those responsible for the development of information, advice and guidance for all ages, to ensure that support and materials on careers in the space industry are easily accessible, including role models (mainly for younger pupils), person specifications, work experience, internships and information on jobs (mainly for older pupils and students).
- Encourage and support the use of space as an inspiring context for learning across all age groups, but with emphasis on
  - supporting non-specialist primary teachers in the use of space in teaching
  - improving the quality and availability of teaching materials using space across the curriculum for primary and secondary schools and for colleges (mainly through ESERO-UK)
  - engaging pupils in STEM through the use of space and maintaining and developing the interest of the most enthusiastic students by providing suitable opportunities
- Develop and implement wider outreach programmes to improve awareness and engagement with the UK’s space programme, in particular by organising a UK Space Conference.

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<sup>9</sup> *Employer Engagement – enhancing HEI engagement with the Satellite Industry for workforce up-skilling and informing policy makers*, Kathie Bowden and Prof Robert Gurney, Reading University, 2012

- Exploit the links that the UK Space Agency has with the European Space Agency, ensuring that resources and activities developed by ESA are fully utilised.

## 6 Analysis: the Skills Pipeline

The decision of an individual to take up any STEM-related career (or indeed to work in the space sector) is influenced by many experiences from early childhood onwards. And space-related learning activities may be used to improve education outcomes at all ages. Hence it is important to consider what interventions are appropriate for each age group and to identify the role of the UK Space Agency and its partners at each stage.

The key partners through the early stages of this process are government organisations (especially DfE and STFC), however the involvement of other organisations (even if only one enthusiastic member of staff, for half a day a year) is very valuable. If 'Space Ambassadors' can be given simple tools that will enable them to promote careers and the appropriate skills to local schools and colleges, they will be able to multiply the impact of other activities.

It is particularly important to ensure that we are actively encouraging the whole population, both male and female throughout the pipeline. Currently women are under-represented in the older age-groups, and there is improved evidence of successful interventions that will engage this sector of the population.

### 6.1 Primary (5-11 years)

At this age, the main focus is on using space for education: space can be used to inspire many different learning activities across the curriculum and can help to demonstrate the excitement of STEM subjects. At this formative stage it is too early to identify students who will go on to careers in space, but children at this age will be forming opinions that will influence their future career choices. Among 10 year olds, the aspiration for a career in science remains persistently low, with children not recognising the wide variety of opportunities that can be opened up by studying STEM subjects at school and in Higher Education.<sup>5</sup> Hence providing suitable role models for STEM-related careers will be valuable for this age group.

Since few primary school teachers are trained scientists, a key requirement is to support non-specialist teachers to give them confidence in teaching science.

Since there are some 21,000 primary schools, activities should aim to reach large numbers (through learning materials, access to space resources, and promotional activities) rather than focusing resources on a few students.

The main partner with responsibility for this age group is DfE. Since their remit is so wide and this is such an important target group for space, the UK Space Agency sees this as a key area on which to focus its resources. Resources and help for non-specialist teachers will be available through ESERO-UK, and there is also a need for activities directed at presenting role models to pupils and encouraging interest in space in primary schools.

### 6.2 Secondary (11-14 years)

All students in this age group will study science and maths at some level through to GCSE, but whether they will study double or triple award science or aspire to a STEM-related career may well have been decided before now. This could also be described as a key milestone to influence whether or not the student embarks on a STEM career. Key aims should be to support, maintain and even to inspire interest in STEM subjects through access to good space-related learning resources that highlight the relevance of the core subjects to real work scenarios and role models. There is also an opportunity to support the inspirational teaching of maths, both in its own right and since this underpins both the study of physics and chemistry as well as the numeracy skills that employers report to be lacking in current graduates seeking employment.<sup>9</sup>

Assistance is being supplied to teachers who want to use space in their teaching through the UK Space Agency's support of ESERO-UK networks and DfE. In addition local companies

and organisations that may have relevant role models on their staff should be encouraged to engage with schools (possibly through provision of suitable materials and in collaboration with STEMNET).

There is also direct contact with the most enthusiastic pupils through special activities such as competitions, conferences, space schools, space camps and other events. The main partner as described above is DfE with support from ESERO-UK. STFC also takes a strong interest through its remit to increase understanding and engagement with STEM.

The UK Space Agency's main contribution is to help identify and promote the many existing and new resources available to assist with teaching, by channelling this information to schools and colleges through the ESERO-UK networks and others.

### **6.3 Secondary (GCSE, 14-16 years)**

By this stage in their education most students will have already made key decisions about their involvement with STEM subjects and will be encouraged to consider their career options in more depth. The interventions suggested for younger pupils can now be enhanced through support of the existing channels (STFC, ESERO-UK, etc), but there can also be a greater opportunity to draw in the more enthusiastic students through space camps, space schools and visits to relevant facilities.

Young people at this stage should be encouraged to keep their options as open as possible, and the possibilities for more vocational routes (alongside more academic routes) to skills training and careers should be promoted to those for whom practical skills are of more interest than the classroom.

This age group falls mainly under the remit of DfE, but STFC is also active. The Agency supports the work of ESERO-UK, Space Studio Banbury and the National Space Academy, but is also actively promoting access to space careers advice, mostly through working with established providers of careers information, advice and guidance. After their GCSEs, fewer girls progress to A Level physics than boys<sup>10</sup>, even when they are equally able, thus limiting their future choices.

In addition the Agency has made a pledge to support the Your Life campaign to encourage young people to consider STEM careers:

*'The UK Space Agency, working with our partners, will use our programmes in space science, exploration, Earth observation, navigation, communication and space technology as an inspiring context for teaching and learning across a range of STEM subjects and across all ages in schools.'*

*'We will use the education and outreach campaign we are planning in support of Tim Peake's mission to the International Space Station in 2015 to engage children of all ages with STEM subjects. We will ensure that the planned activities are appealing to girls as well as boys and will use them to highlight a range of careers that include STEM skills through the use of a wide variety of role models.'*

### **6.4 Secondary (post 16)**

This is the first opportunity that students will have to choose the subjects that they may follow through to a career. These may be in a more academic environment, through technical qualifications or they may combine professional and technical learning with employment following an apprenticeship route supported by an employer and training provider.

For those following a more academic route it is particularly important that interesting and challenging resources are available to maintain their interest and inspire their studies. This first year is also the time that many students really begin to hone their ideas of which subject they will study at university, and the time when talks from role models and visits to university departments or work placements can set the ultimate direction that students will follow. These simple introductions can make a big impact on undecided students.

<sup>10</sup> *It's Different for Girls*, Institute of Physics, November 2012

Similar interventions as at younger age ranges are possible, but there is also the possibility of more exciting challenges – such as involvement in hardware projects. From a teaching perspective smaller numbers of students in classes can provide better opportunities for those interested in space to develop a deeper understanding of particular subjects.

The main partners with responsibility for this age group are DfE (in schools) and BIS (in colleges). STFC and ESERO-UK are also active. The Agency's main involvement will be through its support of the ESERO-UK Space Ambassador scheme and in promoting careers in order to fuel the supply of skilled young people interested in careers in the space sector. While the overwhelming need in the space sector is for graduates, there is useful evidence of the requirement for and relevance of apprenticeships in a report from Kings College London.<sup>11</sup> The Agency will therefore also help support the provision of suitable apprenticeships where appropriate – for example the National Higher Apprenticeship in Space developed by the National Space Academy.

## 6.5 Higher education

As students head into tertiary education, they will have made their choice of subject and general career direction, but few will have identified anything more concrete than 'engineering' or a particular science. Most are unaware of the space sector and particularly that the UK has one. Support in terms of careers information, and propagation through student societies can make a big impact.

The Space Placement in INdustry (SPIN) scheme, initiated in 2013 is also making an impact, and support from the sector itself will be important to increase the number of placements that can be identified for undergraduates across the sector. This new scheme has three key objectives: to introduce the interns to the breadth and depth of the sector (which in many cases the students have no knowledge of), to provide students with an experience that helps them to appreciate the skills needed for careers in the sector (both in industry and academia) whilst they are still in a position to influence their own learning choices, and to provide them with an environment where they can showcase their own skills and abilities to a range of employers. The impact and profile of the scheme has grown, and the first cohorts are now moving into their first jobs or on to further study. The scheme is open to students and organisations from across the country.

A new course leading to a Higher Apprenticeship qualification will encourage those daunted by the introduction of university fees to embark upon studies which will lead them towards a degree qualification, but through a vocational route. Whilst these students will be encouraged through their studies to experience the industry and engage with other organisations in the supply chain, students studying traditional generic STEM subjects will not necessarily gain that insight. Therefore encouraging work placements during summer vacations and providing appropriate signposting to careers and further study options will be imperative. This should be facilitated through the existing SPIN mechanism in order not to dilute or fragment the signposting.

In this age group, the principal focus will be to use education for space – for example through engaging with employers and universities to ensure that UK graduates are encouraged to acquire the skills that the sector requires. The main partners with responsibility for this age group are BIS, universities and the Satellite Applications Catapult. The Agency's national skills point of contact will work closely with industry and the universities to provide a feedback loop on gaps in skills training, to promote career opportunities and placements and to improve access to international space education opportunities.

## 6.6 Postgraduate education

Increasingly graduates are considering postgraduate studies, either taught (e.g. masters courses) or research-oriented PhDs. This is partly driven by shortages of new graduate-level roles, and partly by the knowledge that more in-depth knowledge in particular areas will

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<sup>11</sup> *Space for Technicians? An analysis of technician duties, skills and training in the UK space industry*, Paul Lewis, Kings College London (Gatsby), 2012

increase employability. New support for student loans for young people aiming for a masters will make a difference to this cohort.

Employers are particularly interested in masters graduates as this level of study confers further depth of knowledge without being too focussed. Universities have risen to the student funding challenge by integrating a 'masters' year onto a 3-year BSc, creating a 4-year degree programme for suitably qualified students. The Research Councils, who fund a significant proportion of PhD studentships within the UK, have approached the problem from another perspective, by extending the length of the programme and incorporating taught modules into the early training for many of their PhD students, particularly in Centres for Doctoral Training (CDT) or Doctoral Training Partnerships (DTP).

The Agency will work in partnership with relevant Research Councils (e.g. EPSRC, NERC, STFC,) to support relevant cross-sectoral postgraduate training which will improve the connections between existing Centres for Doctoral Training and Doctoral Training Partnerships and space sector organisations. The objective will be to ensure that PhD students from a range of academic backgrounds are able to develop relevant specialist and business skills that are needed in both the upstream and downstream space sectors. This training could, for example, be effected through the development and delivery of short courses with equal relevance to other areas of high technology.

At this level graduates are better informed about their long-term career options, and generally employers make their own connections to the community. However SPIN could usefully incorporate a brokering mechanism to connect departments teaching masters courses with local organisations able to provide projects that could form the basis of a masters dissertation, or CDTs/DTPs with companies interested in hosting a PhD placement for 3 months- as well as encouraging local companies to participate in relevant careers events. This could be particularly useful for linking the academic community to SMEs. Universities hosting CDTs/DTPs also recognise that it is important to provide careers advice early in the PhD programme, as not all students will go on to a career in academia. Providing this advice to PhD students is particularly pertinent in related non-space disciplines, since they will have extremely relevant and transferrable skills.

## **6.7 Continuing professional skills development**

An important role of the Agency's national space skills 'point of contact' will be to help signpost the range of opportunities available for skills development provided by a wide range of existing providers. These will range from Knowledge Transfer Partnerships (graduate or postgraduate placements within organisations), through business, technology and entrepreneur skills training provided by further education colleges, universities and business schools, training organisations and ESA.

The Agency will work with employers to identify areas with particular skills shortages, and little or no training provision. It will also work with other funding agencies (e.g. Innovate UK) to support the development of training provision that will enable the up-skilling of existing employees or the re-skilling of personnel with appropriate backgrounds from other sectors.

SMEs in particular feel under pressure from a financial and manpower perspective, and it would help to demonstrate to them how recent graduates or postgraduates could assist them under the Knowledge Transfer Partnership scheme to grow their skills and workforce.

The larger multinational companies have their own graduate training schemes, where they introduce their new starters to many different aspects of the organisation, including their non-technical departments. In some cases they are working with organisations within their own supplier chains to involve them in the schemes. This has the benefit of improving customer/supplier relationships and embedding knowledge of risks and opportunities throughout the supply chain. The Agency will support these initiatives and encourage their further development. It will also investigate with the professional organisations in the sector whether there is scope for the development of a generic graduate training programme (modelled on a programme offered by the Australian Institute of Mining and Metallurgy for their SMEs).



## 6.8 Informal education

There are many informal space education activities across the UK. The UK Space Agency's main role will be to encourage and promote the best of these. A funding scheme, 'Space for All', has been set up to facilitate this by supporting innovative education and outreach activities across all of the regions of the UK. All suitable education resources developed with UK Space Agency funding (such as through the Space for All scheme and the Tim Peake education programme) will be made available to teachers through the ESERO-UK eLibrary. The ESERO-UK network will conduct a review of existing activities and will, through its website, support providers to help them meet criteria to join the STEM Directories ([www.stemdirectories.org.uk](http://www.stemdirectories.org.uk)) which have a very broad take-up from schools and colleges.

## 7 Partners

This Strategy will be delivered by the UK Space Agency working with its partners. These include:

- Government and agencies (Department for Education, Department of Business, Innovation and Skills, together with their agencies and the Research Councils – STFC and NERC in particular – and the European Space Agency),
- Space education and outreach organisations (in particular ESERO-UK, but including the National Space Centre and its Space Academy, as well as many regional organisations),
- National education bodies,
- Representative groups (such as trade bodies, student groups, professional institutions, and teacher networks),
- The space sector (including companies and research groups in universities to help improve outreach, access to role models and support for educational initiatives).

## 8 Conclusion

This document presents the background, rationale and goals of the UK Space Agency's Education, Skills and Outreach Strategy.

It will be used to guide specific actions to be taken by the UK Space Agency and its delivery partners.

It will be updated as appropriate to take account of lessons learnt and wider policy developments (for example to take account of changes in the UK Civil Space Strategy).