Figure 1 Children examine lunar samples

USING SPACE TO INSPIRE AND ENGAGE CHILDREN

Allan Clements and his colleagues explain how ESERO-UK and its resources can support you when using space as a context to inspire teaching and learning of STEM subjects

Key words:
CPD
Types of activity

The European Space Education Resources Office (ESERO-UK) is a project of the European Space Agency (ESA) and national partners including the Department for Education (DfE), The UK Space Agency (UKSA) and the Science and Technology Facilities Council (STFC). The key objective of the project is to promote space as an exciting inspirational context to enrich the teaching and learning of science, technology, engineering and maths (STEM) subjects. In the earlier phases of the project, ESERO-UK did much of its work with secondary school teachers (Clements, 2012). Since the King's College London ASPIRES project report on the lack of 10-year-olds wanting to take up science (ASPIRES research team, 2013), our work has increasingly focused on primary school teachers in order to encourage more children to pursue a STEM-based career.

The project makes use of ESERO-UK's network of 'space ambassadors' (see *Websites*), who have arranged and facilitated several interventions using a space context, such as continuing professional development (CPD) sessions for teachers, visits to planetaria and use of its resources such as *Is there anyone out there?* (Box 1).

We are investigating the impact of using space as a cross-curricular context for science, looking particularly at:

- enjoyment and engagement in science lessons;
- confidence in learning science and in scientific enquiry skills;
- awareness of the importance of science to society;
- knowledge of STEM career opportunities;
- attainment.

Resources for the primary science curriculum

So what support and resources can ESERO-UK provide? How is it hoping to make an impact in the areas identified above?

In addition to the network of space ambassadors, we have an extensive range of resources and CPD available for teachers, ultimately helping to achieve our objective of extending knowledge and interest in space and in science more generally.

ESERO-UK is working with its partner organisations, the National Science Learning Centre for CPD delivery and the National STEM Centre, whose website is used to host a wide range of teaching and learning resources (see *Websites*). The primary science area contains resource lists that cover the new curriculum, consisting of lesson plans, activities and video-clips (Box 1 gives more detail of some of the specific space resources). They contain tips on using the resources, suggestions for further use and background subject knowledge

Box 1 Space resources

Is there anyone out there?

From: **www.nationalstemcentre.org.uk**

This resource is proving very popular as both a downloadable resource or as part of CPD delivered by the space ambassadors. It contains nine practical activities and uses the context of exploring Mars for the evidence of life. The activities are organised into three themes, life, landscape and landing, covering the curriculum areas of rocks, soils and volcanic activity as well as touching on micro-organisms. The resource covers substantial areas of 'working scientifically', developing a range of enquiry skills and covering mathematics, geography, literacy and ICT.

Borrow the Moon

From: **www.stfc.ac.uk/1360.aspx**

Did you know that you can borrow the Moon? STFC has a scheme whereby schools can borrow free for one week small pieces of lunar rock and hand-held meteorites (Figure 1). The teaching materials have also recently been updated by the ASE, with ESERO-UK and Millgate House Education, with activities linked to literacy and communication, such as 'Moon talk', and investigations such as 'Meteorite Detective'.

Really big rocks

Down2Earth simulator: **down2earth.eu/impact_calculator**

If you want to move from looking at small rocks from the sky to what happens when really big rocks (asteroids or comets) hit the Earth, then a great simulator is available online. *Down2Earth* allows children to change the speed and size of an object to see the effects on the Earth and observers nearby. Children love being able to choose their home location, using the integrated Google maps function, and create a huge crater! This simulator gives data that can be used in numeracy and for plotting graphs, clearly developing maths and presentation skills as well as analytical ones. You could even get them to simulate the impact of a comet like the one that the European Space Agency's *Rosetta* spacecraft has landed on.

Train like an astronaut!

Mission X: **trainlikeanastronaut.org**

Uses the context of astronaut training to encourage children to exercise, eat well and understand the science behind these topics. The programme for 2015 will start early in the spring term.

ESA Kids

ESA Kids website: **www.esa.int/esaKIDSen**

Contains some great activities that children can use to research homework assignments or just have fun.

Real life space missions

The ESERO website, www.esero.org.uk, highlights ESA's current space missions including Tim Peake's mission to the *International Space Station* (Figure 2, Box 2), *Rosetta* (the spacecraft that has landed on a comet with the objective of exploring what it is made of) and *Gaia*, the space telescope (launched at the end of 2013 to map the location and position of a 100 million stars in our own galaxy, the Milky Way). Sharing this information with children is an ideal start for any science lesson.

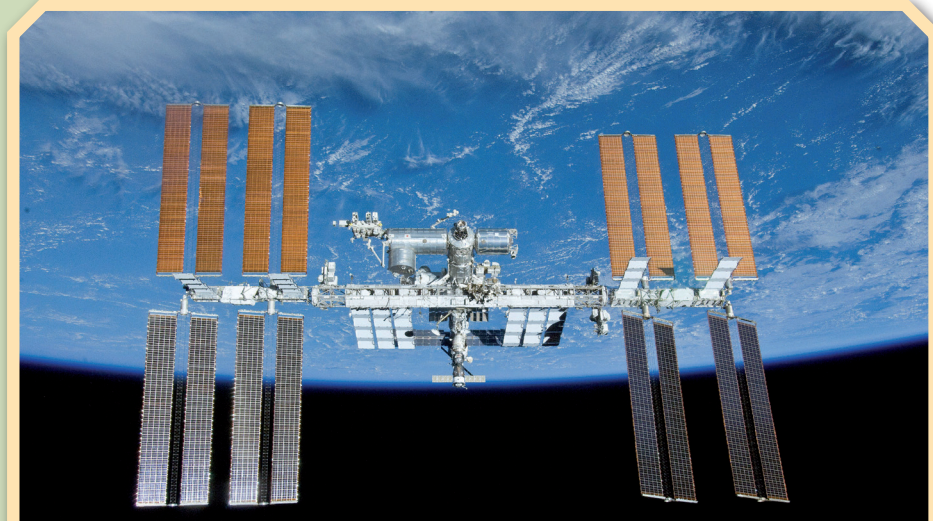

Figure 2 The International Space Station seen from the departing Atlantis space shuttle, 23 May 2010. Photo: NASA (S132-E-012208)

Web chats with scientists

WEBEX, **www.webex.co.uk**, allows online conferencing and sharing of documents. You don't need any software to be able to use it and the meeting/chat is only open to the invitees. ESERO-UK arranges for primary school classes to speak directly with space scientists using WEBEX (see Box 3 for an example).

Box 2 Tim Peake's flight to the International Space Station (ISS)

Figure 3 ESA astronaut Tim Peake, from the United Kingdom, training with the Soyuz simulator in Star City, Russia in September 2010

Tim Peake (Figure 3) is the UK's first official astronaut. He will travel to the International Space Station on a Russian Soyuz rocket in November 2015 and be responsible for conducting scientific experiments as well as carrying out routine duties, such as maintenance, as part of the ISS astronaut team. The UK Space Agency with ESA are organising many educational outreach activities to support schools to engage with the mission, including Tim's twitter feed, the Space Dinners competition (launched in May this year), and the current location of the ISS. There will be a great deal of media interest in the mission and it is a key objective that it inspires children to engage, enjoy and continue with their science and maths studies.

See: **www.nationalstemcentre.org.uk/timpeake**

Box 3 Whitton Primary School Ipswich, chats with a European Space Agency scientist

When ESERO-UK offered our school the chance to web chat using WEBEX (see Box 1) with Nigel Savage at ESA, a space scientist based in Holland, we were really excited!

Before we could get to the point of asking questions, we needed to overcome two hurdles. First, the year 4 children (ages 8–9) involved had not been taught about space in school, so their existing knowledge and understanding had come from books, TV and films such as *Gravity*. So, keen to get the children thinking about the life of an astronaut, I used ESERO's *International Space Station* and *Mission X* resources (see Box 1).

The second issue was that because of the poor levels of oracy in our school community, some of the children would find framing questions exceptionally difficult. So I developed a 'Question Quibble' (Goldsworthy, 2007) to provide our children some vocabulary to work with. The children were responsible for quality-assuring their own questions and deciding which we could answer ourselves and which we would ask Nigel.

We used a webcam and speaker connected to the whiteboard, laptop and speakers so that everyone could watch. We organised the classroom so that there was a hot seat in front of the computer with a plain screen behind to minimise issues with 'bandwidth'. Any child with a question could then simply sit in the hot seat and ask it. This allowed the equipment to stay in one position and reduced the possibility of a technical hitch!

The impact on us all was profound; thinking about space is always humbling and thought provoking. However, I feel that as we watched the web chat, something deeper was going on in the hearts and minds of the children. Most of us never meet scientists who work on space programmes, let alone ask them our questions. However, that was the reality for our children, whose questions were taken seriously. This was a poignant experience.

Figure 4 Whitton Primary school pupils performing experiments with rockets after their web chat with ESA

The children challenged their ideas about scientists too! In talking with Nigel they could see that scientists are not weird people in white coats, but normal people in normal clothes. They discovered that scientists don't talk a mythical, boring language that no one understands, as they had a meaningful conversation about space at their level. Nigel had some great stories and was really entertaining!

The children also asked a couple of questions that Nigel could not answer. As teachers we always tell children that it is OK to not know an answer, and it was brilliant for them to see that Nigel did not know everything! He was honest and open about his journey as a scientist and encouraged the children to follow their dreams.

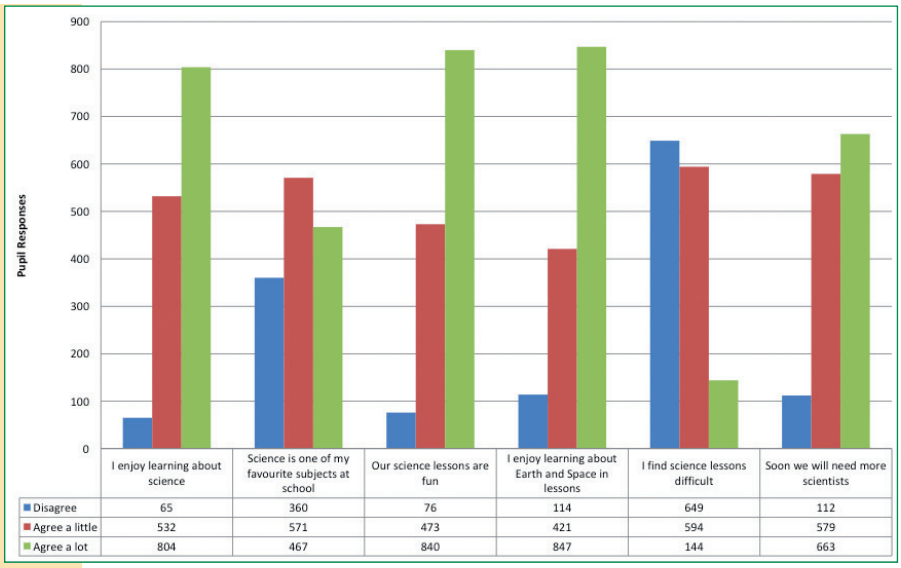

Figure 5 Children's engagement with science, pre-project responses

whilst also helping to develop the skills of 'working scientifically'. Possible misconceptions are highlighted so that teachers may plan lessons to facilitate correct conceptual understanding.

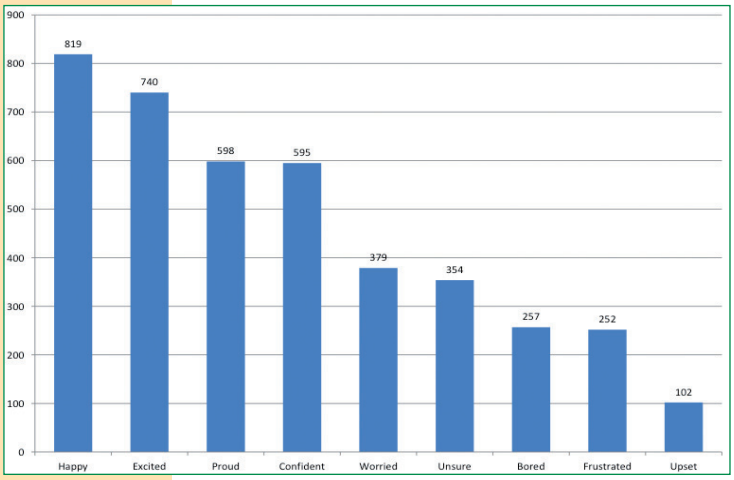

Figure 6 Children's feelings about science careers, pre-project responses

Space Education Quality Mark

ESERO-UK offers schools the opportunity to show how successful they have been in using space in their curriculum to enthuse children. The Space Education Quality Mark (SEQM), supported by STFC, is an award given to schools that have shown significant use of the context of space in STEM subjects, raising the profile of both, have worked with other organisations, shared resources and used space to enrich the curriculum, all of which have benefits beyond just gaining an award (see *Websites*).

Investigating Impact!

ESERO-UK is attempting to measure the impact of the activities on primary children's engagement with science as mentioned earlier. In order to establish a base line, children were asked to fill out a pre-project questionnaire. Children will also fill in a post-project questionnaire and then we will analyse the differences in their responses. Teachers will also be interviewed at the end of the project to measure any increase in children attainment.

Results from the baseline data indicate that children are already interested and understand the importance of science (Figure 5). The results show that children find science easy, perhaps indicating that we could stretch their imagination and understanding further, hence some of our resources for primary children might appear more challenging than you would normally encounter. There are also some positive attitudes to science careers (Figure 6), such as the high responses for being 'proud'; 'happy' and 'excited' also score highly, indicating that all of the support for primary science over the last decade is beginning to pay dividends.

As usual, collecting anecdotal data from the classroom always shows a positive, enthusiastic response from teachers and children alike. We are now in the process of collecting the post-project questionnaire and attainment data and hope to be able to produce further evidence to demonstrate that using space as a context encourages more children to enjoy and continue with their science studies.

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Acknowledgements

Tom Lyons, ESERO–UK Teaching Fellow; Alice Coates, Communications Coordinator, Myscience; Rachel Jackson, Primary Specialist, National STEM Centre; Claire Seeley Whitton Primary School, Suffolk; Science Learning Centres and National STEM Centre.

Allan Clements is ESERO-UK manager. Email: a.clements@nationalstemcentre.org.uk

Websites

European Space Education Resources Office: **www.esero.org.uk**

Lists of resources and support materials: **www.nationalstemcentre.org.uk/primaryscience**

National STEM Centre ESERO area: **www.nationalstemcentre.org.uk/elibrary/collection/113/esero-uk**

Space Ambassadors: **www.esero.org.uk/space-ambassadors**

Space Education Quality Mark: **www.esero.org.uk/seqm**