

principia
mission

SPACE DIARY

Inspired by Space:
Engaging Girls
in STEM



A Guide to Engaging Girls in STEM with the Principia Space Diary

Contents:

Introduction by Kristen Harrison	/ 4
Women in STEM Statistics	/ 6
A Primary Teacher's Perspective by Claire Loizos	/ 8
Five Tips for Inspiring Girls in STEM	/ 13
1. Introduce Positive Female Role Models	/ 13
2. Unlock Science with Communication	/ 16
3. Use Creativity and Collaboration to Embed STEM Learning	/ 21
4. Encourage Home Learning	/ 26
5. Exploring Science Outside the Classroom: Museums, Science Festivals and Libraries	/ 29
Useful Links and Resources	/ 30



Introduction

In 2015, Curved House Kids were given an amazing opportunity. Together with Lucy Hawking, and with support from the UK Space Agency, we were tasked with producing an education programme for primary-aged students. Our goal was to get students excited about space exploration and STEM learning using ESA Astronaut Tim Peake's Principia mission as the inspiration. This opportunity came with an important challenge, to ensure the programme worked as well for girls as for boys. Anyone who has seen footage of Tim Peake will know what a positive and empowering role model he is, so we needed to ensure that his influence reached girls too, enabling them to see themselves as the astronauts of the future.

It was largely thanks to author Lucy Hawking (herself, a wonderful role model) that we were able to recruit the help of women like Britain's first astronaut Dr Helen Sharman, astronomer Dr Sheila Kanani, the UK Space Agency's Libby Jackson, engineer Vinita Marwaha Madill of Rocket Women and Tim Peake's mission director Berti Meisinger. The more we developed the programme, and learnt what it takes to send a person into space, the more we realised how many women there are out there working in science to better our world. Our mission soon expanded to helping girls see themselves not just as future astronauts, but to opening their eyes to the huge array of roles the STEM

sector offers: chemists, engineers, biologists, nutritionists, doctors, medical researchers, astronomers, physicists and more. And IT experts, project managers, communications directors, designers, photographers, marketers and other creatives working alongside STEM experts. So many futures!

Once the *Space Diary* was out in the world we started to receive feedback from teachers and home educators. It was immediately evident that the programme was working and that girls were showing equal interest. We were humbled by pictures of the Space Diaries in action that teachers sent in (see a digest of these on our mission feed: <http://principiaspacediary.org/mission-feed/>) and were amazed by the ideas and innovations that teachers were coming up with. One teacher, Claire Loizos, was working in an all-girl school and was totally nailing it. She used the diary as a framework and extended it far beyond anything we had imagined. She linked it in with other Principia programmes, and other subjects areas, and her students were visibly enthralled, embedding a love of science through each new activity.

Claire showed us what girls can do when they are nurtured to use their smarts. We were so inspired that we asked her to work with us on this guide and combine her classroom experience with our materials and learning methods. We hope these ideas will make your teaching life that little bit easier and help you inspire a new generation of girls in STEM.

Oh, and let's get one thing straight: this guide is not just for girls. I know, the title suggests otherwise, but that is just to get your attention. This guide is for all students because girls don't need special activities – they simply need to be seen, heard and appreciated. These are activities that will give girls the confidence and visibility they deserve.

**GO FORTH
AND CONQUER!**

*Kristen Harrison
Publisher, Curved House Kids*

Women in STEM Statistics

UK STEM skills shortage? The solution is right here.

50% AT GCSE

Girls outperform boys in GCSE science subjects, with near equality in numbers taking these exams.

34% AT A-LEVEL

After GCSE, the number of girls in STEM starts to diminish.

7% IN HIGHER EDUCATION

By university, just seven per cent of women take degrees in technology and engineering.



A lack of female talent in STEM careers is not just a waste of resources, it's a major disadvantage for the UK in a global sense. Here's why:

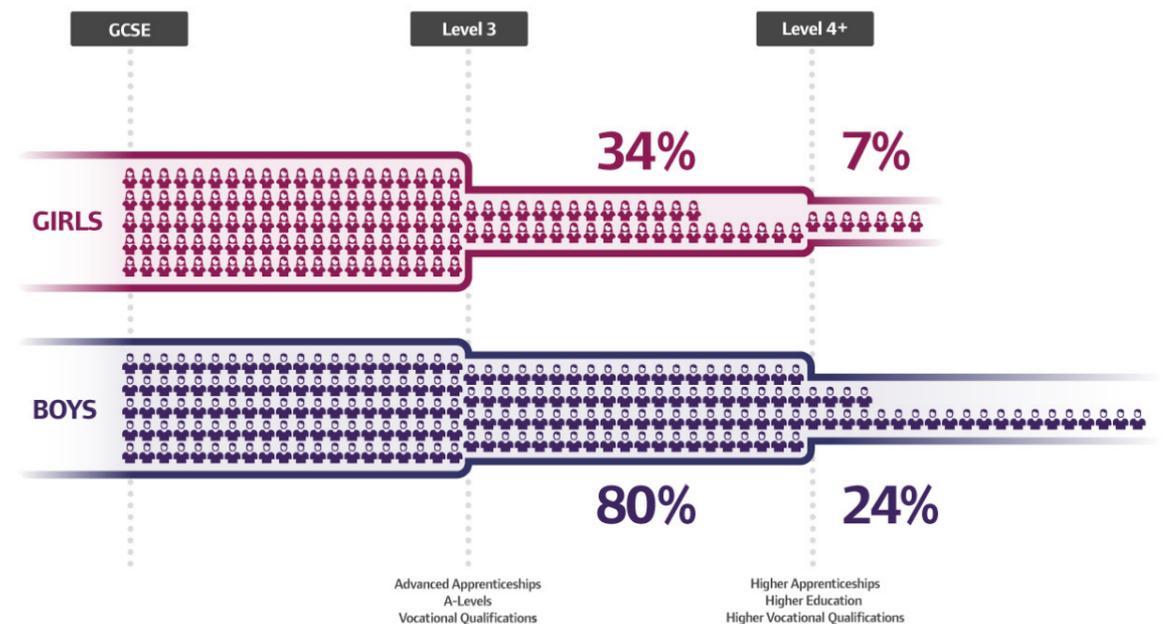
SKILLS SHORTAGES / The UK has a STEM skills crisis across all sectors. The WISE campaign estimates a shortage of 69,000 recruits a year. At the same time, only 7% of women are choosing STEM careers. We are filling these STEM roles (at great expense) with talent from abroad when the real talent is right here at home – among our female population.

COST TO THE ECONOMY / The gender gap in the sciences is estimated to cost the UK a whopping £2bn per year (Women's Business Council, 2015). What a waste. Imagine how many talented girls we could educate and upskill with that budget.

COMPETITIVE ADVANTAGE / Diverse workforces are proven to be more successful and more competitive. Having a range of backgrounds, ideas and experiences means better problem solving and more flexibility to embrace change. This is especially important in science and technology.

NEW PERSPECTIVES / We could debate all day about whether gender is nature or nurture but one fact is indisputable: women and men have different experiences of the world simply because of their gender. Men and women have different expectations, assumptions and stereotypes placed on them and that means a whole different outlook. An effective workplace will embrace and challenge those perspectives, and make sure they work well together.

The STEM Education Pipelines



Statistics: WISE Campaign, 2016, www.wisecampaign.org.uk

A Primary Teacher's Perspective

by Claire Loizos

Claire Loizos is a passionate advocate of STEM learning with both primary and secondary teaching experience. She is now the Key Stage 2 Lead Teacher at Broadlea Primary on the Isle of Wight, before which she was Head of Science at an all-girl school in London.

Having worked in science education for nearly a decade, I have witnessed first-hand the strange divide that can exist amongst genders in and out of the classroom. This led me to a career move a few years ago, a transition from Secondary to Primary Science, and from a mixed to an all-girl classroom. There were many reasons for this move, but my main motivation was to get to grips with what girls want from science and STEM learning. It was a bit of an experiment, to try new things, to evaluate, and to explore how girls learn best. Over the past few years I have experienced all sorts of challenges and opened up the learning to the girls themselves, asking them how they learn best. The results... high achieving, inspired young scientists, many of whom now aspire to careers in STEM.

I hope that this guide will provide hands-on activities, questions and themes to inspire girls within your classroom and to overcome the challenges I have faced in my own experiences. All of these ideas are based on first-hand experience, classroom observation and research, and all of which have been evaluated and adapted based on pupil voice specifically for this booklet. Here are some of the things I've noticed in the classroom.

GIRLS NEED TO SEE THEMSELVES AS SCIENTISTS

Girls often have a picture of scientists and engineers as older, grey haired men that play with chemicals or bury their heads in books. In my first lessons getting to know classes I often ask them to draw me a 'scientist'. Almost every time I am met with a man, looking like Einstein in a white lab coat, often with a table of 'potions' and books. Try it. See what you get. This is the first hurdle we face... how do we get girls to see themselves in that image? In this booklet you'll find lots of ways to ensure girls identify themselves as a scientist, even directly through adding their picture to the front cover of the Space Diary!

"Tell me and I forget. Teach me and I remember. Involve me and I learn."

- Benjamin Franklin

PRACTICAL VS THEORETICAL

Girls, like boys, all learn in different ways. In my experience whether teaching in a mixed classroom or not, all children learn best from being hands-on. I have lived my teaching career through two quotes: Benjamin Franklin's "Tell me and I forget. Teach me and I remember. Involve me and I learn," and Walter Barbee's "If you've told a child 1000 times and they still do not understand, then it is not the child that is the slow learner." We all know this is true; we have to constantly adapt and make learning accessible to the million ways that children can learn. It is hard.



/ Claire Loizos and one of her space-crazy pupils meet ESA Astronaut Tim Peake at 10 Downing Street



Under all the added pressures of being a classroom teacher it takes effort to also be adaptable and creative. I have found that open tasks that require children to 'learn on their feet' and choose their own methods of application have worked wonders at encouraging girls to take ownership of their own learning; with huge increases in enjoyment and progress. The ideas and activities in this booklet bear this in mind, providing minimal teacher input and maximum pupil effort, encouraging independence whilst allowing girls to be creative.

TAKE A RISK!

Girls are just as capable as boys. In my experience they are less comfortable with taking risks. Risk taking is part of science and engineering and we have to encourage

our girls especially to develop the resilience and confidence to do this. Many of the tasks and ideas in this booklet require children to guess and encourage them to get it wrong, after all that is why we are all here... to learn! Try to use language such as 'Take a risk' and 'It is ok to get it wrong' getting them to reflect on the learning process and to find a new way or solution. Reward and praise that behaviour, and subsequently creating a safe classroom environment within which they feel comfortable to take chances and ask questions that drive their learning and enjoyment.

GIVE STUDENTS OWNERSHIP

Girls like to feel that they have been involved in the learning process. In my experience, girls have been more positive, more inspired, and made the most progress when they have had opportunities to reflect and feed back.

Give them opportunities to find out answers to their own questions, and ask them for feedback on tasks, they will surprise you with their maturity and depth of ideas. By involving them in the learning process they feel engaged and inspired, consequently increasing their enjoyment.

INCREASING SCIENCE CAPITAL

Science Capital is a relatively new term to STEM education and it is hugely important. It is also a concept that makes it easy for us teachers to see how we can create valuable science learning experiences inside and outside the classroom.

What is Science Capital?

If someone has lots of 'Science Capital' it means they have a lot of scientific knowledge but also a rounded interest and understanding of science. It means they have experienced science in different parts of their life. Children can develop Science Capital through exposure to science in various different contexts, including participation in science at school, knowing a scientist among the family and friend network, visiting museums and galleries and encountering science in films, on TV, in books or in the media.

There is so much that can be gained from understanding how the world works and from being able to think like a scientist. These are things that can empower young learners, whether they will pursue a career in science or not. In my opinion, the way in which Science Capital promotes learning in lots of different contexts (including through experiences and relationships) makes it a really good model for looking at ways we can inspire girls in STEM. We know that children learn best and make

the most progress when they are able to experience learning through a range of mediums, both inside and outside of school. Being exposed to outstanding lessons within the classroom is what we all hope for, however increasing their exposure outside of the classroom is equally as important. I have found it beneficial to set home-learning tasks that require girls to watch documentaries or explore online portals, as well as to perhaps visit local scientific sites. All of these activities increase their exposure outside of the classroom. STEMnet and their programme of visiting Science Ambassadors have also opened up a wealth of free resources, allowing me to expose students to women who already work in within the STEM field, opening up minds to careers they have never even heard of, such as wildlife photographers, biochemists, pharmacists and astrobiologists.

All of these challenges are also true of girls and boys in secondary schools. If we can start to open their eyes and boost their confidence now, we will see this filter through to secondary schools, colleges and universities, hopefully increasing the 20% of women working in STEM in future years. How proud will we feel knowing we have directly increased this figure, knowing that our girls are working in careers that don't yet exist, and that we inspired and prepared them for that.

I hope you enjoy this guide,

Claire Loizos
Primary School Teacher



Five Tips for Inspiring Girls in STEM

In this section we share our top tips for inspiring girls along with ideas and activities that link to the Principia Space Diary. Download free teaching notes, lesson plans and curriculum guides from <http://principiaspacediary.org/>.

1. INTRODUCE POSITIVE FEMALE ROLE MODELS

One of the most effective ways to promote STEM careers is to show girls other female scientists and experts who are doing amazing things in this world. We need to show girls that they can be astronauts, engineers, doctors, biologists, physicists and many other things. We also want to show them that there are important roles within science for other types of skills, like writing, communications, design and photography. Did you know, for example, that science imaging (photographing and documenting all things science-related) is one of the most exciting careers at the moment and also highly creative. This is just one example of how diverse the careers are within STEM and how many intersections there are with careers that girls are often encouraged to pursue.

We also need to strive for diversity of people, as well as jobs. We can do this by disrupting the stereotype that every scientist looks like Einstein and by showing girls that scientists come from all backgrounds, are any gender, and have different personalities, interests and skills.

ACTIVITY /
AWESOME WOMEN IN SCIENCE

Meet the amazing women in STEM who appear in the *Principia Space Diary*. Pictured here are writers, space experts, astronomers, engineers, chemists and even the first Brit in space – astronaut Helen Sharman. Can your students research and write a profile on these experts? See page 32 for links to space careers resources.

Older students might like to research STEM careers outside the space industry too. Women like Cori Bargmann (neurobiologist), Holley Moyes (anthological archaeologist), Jennifer Eberhardt (social psychologist) and Maryam Mirzakhani (mathematician) are all leading experts in their fields.



LUCY HAWKING

Author of the *Space Diary* and of the *George's Adventure* series in which George explores the universe!



DR SHEILA KANANI

A British astronomer who we meet in our introductory video for Chapter 4.



LIBBY JACKSON

Former Mission Director who coordinated the Principia education programmes.



SUSAN BUCKLE

Astronaut Flight Education Programme Manager at the UK Space Agency.



HELEN SHARMAN

Helen Sharman was the first Brit to go into space when she visited the Mir space station in 1991.



CINDY FORDE

Special Advisor to the President of Ubiquity University and former CEO of Cambridge Science Centre with an award-winning career in sustainability.



VINITA MARWAHA MADILL

Space Operations Engineer at the ESA and former spacesuit designer.



BERTI MEISINGER

Tim Peake's Mission Director who was responsible for coordinating his activities when he was on the ISS.

2. UNLOCK SCIENCE WITH COMMUNICATION

Girls tend to have stronger communication skills (particularly verbal) and this can be a great bridging skill to science.

Girls also tend to demonstrate their empathy and emotions more readily (whether that's nature, nurture or society is an ongoing debate) and tapping into this can be a powerful way to unlock learning.

The *Space Diary* is a great tool for empowering students with a range of communication skills. On the following pages we highlight three literacy and communication activities that allow students to generate ideas, express feelings and emotion, and create stories related to the science they are learning.



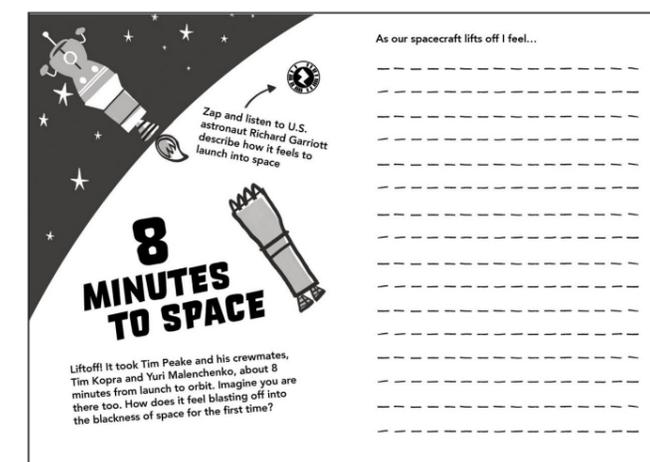
ACTIVITY / 8 MINUTES TO SPACE

<http://principiaspacediary.org/activities/8-minutes-to-space/>

In Chapter One, the activity '8 Minutes to Space' provides a wonderful framework to explore science communication. Students are asked to imagine what it feels like in the first few minutes after blasting into space. To get them into the zone there is a video of US astronaut Richard Garriot describing his launch (<http://principiaspacediary.org/chapter-one-richard-garriot-on-being-an-astronaut/>) and students can also watch Tim Peake's launch video (<https://youtu.be/bSfYdr8Oj9w>).

Encourage your students to record sounds, feelings and thoughts about being an astronaut taking off for the first time; explore 'How would you feel in that 8 minute launch?' Students can then explore different ways of communicating their feelings. Here are some ideas that have worked:

- **Diary:** Can students write an emotive diary entry from the point of view of an astronaut?
- **Video interview:** Can students record an interview using iMovie or video on a tablet? Can they play the role of an astronaut who has experienced launch?
- **Poem:** Can students convey their thoughts and feelings of a launch in a poem?
- **News report:** Can students convey the launch in a formal manner? This could be through use of a video recording on an app, or in the written format of a newspaper report.
- **Radio:** Can they record an audio description of the launch? Show them the live reporting of the launch and get them to write a script and record their own audio commentary.



ACTIVITY / LOOKING AT EARTH FROM SPACE

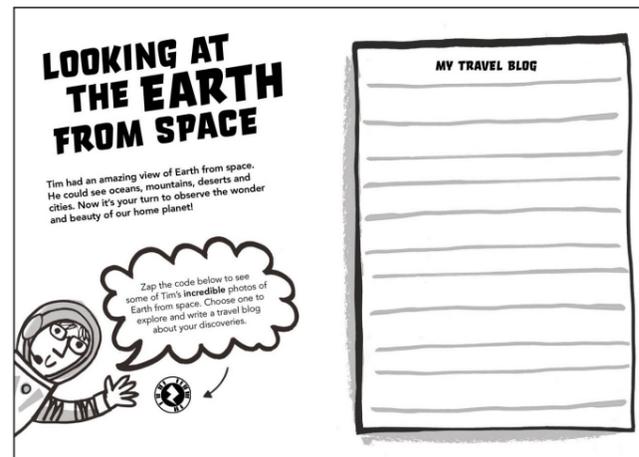
<http://principiaspacediary.org/activities/looking-at-earth-from-space/>

Visual media can be a hugely powerful bridge to science and space gives us the perfect opportunity to explore this. While astronaut Tim Peake was in space he took some incredible images of Earth, showing an amazing perspective of our planet. In this activity students will write a travel blog about an unvisited place, using Tim Peake's Earth images as inspiration. Explore their communication skills by asking them to delve deeper through these ideas:

PRESENT / Ask students to present on their chosen location. Ask them why they chose it. Was it different from how they imagined it to look? What audience might like to visit this location and why? Get them to persuade the class to visit it and then have a blind vote and see where the class chose to go after all have presented.

STORY TELLING / Ask them to use this location to write a short story. An astronaut has crash-landed here and is looking for help. Can they put together a short story (perhaps with images) using Tim Peake's photos to develop their setting ideas? Perhaps they could share their stories with younger years, focussing on their intonation when they speak.

BLOG / Put together a class blog using Wordpress (<https://wordpress.com/create/>) with each student contributing their travel blog on a real blogging site. Perhaps they could share this with parents. Encourage them to comment on each other's blog posts as a form of peer review and feedback.



/ ESA Astronaut Tim Peake took some amazing images of Earth from space – perfect visual writing prompts! What are some of the things these images tell us about Earth, that we can't see from the ground?

<https://www.flickr.com/photos/timpeake/albums/72157660209464584>

ACTIVITY / SPACE HISTORY TIMELINE

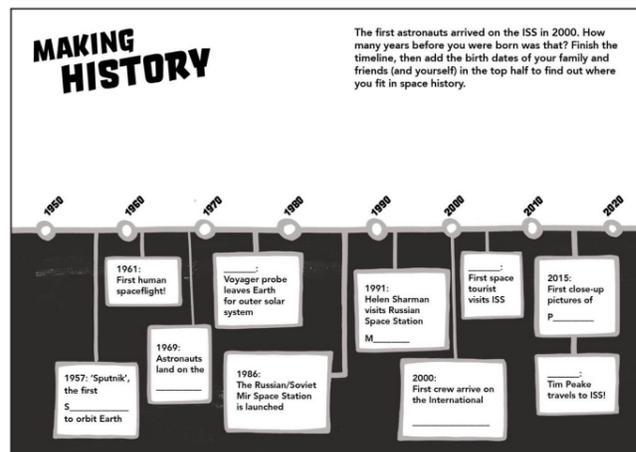
<http://principiaspacediary.org/activities/making-history/>

In Chapter Five, pupils start by exploring the history of space exploration. Offer your students the opportunity to broaden this and involve their family and friendship network. Ask them to interview teachers, family and friends about where they fit in with this timeline and their experience of some of the events. Start by generating questions about each event and then ask them to use lesson and home time by being the interviewer and recording responses. Not only are they developing their use of punctuation, such as speech and question marks, but they are able to report write and compare points of view.

Key questions could include:

- Where were you on 15th December 2015?
- What did you think of Tim Peake's launch?
- Did you watch Neil Armstrong land on the moon?
What was it like?
- What are your thoughts on space exploration?
- Who is your favourite astronaut?

To summarise this activity, pupils could communicate different points of view by adding quotes and opinions to their timeline or to create a family view timeline of space.



3. USE CREATIVITY AND COLLABORATION TO EMBED STEM LEARNING

Learning by doing is arguably the best way to engage students and further to that, embed new knowledge. Creative practice is particularly important in science and STEM because so much of it is about generating ideas and thinking outside the box in order to solve problems.

We already know that integrating the arts into STEM (ie. STEAM) is an effective way of breaking down barriers to learning that many students face – this includes reading difficulties, communication challenges, mental block, self-esteem issues or even just boredom. Many girls suffer a mental block from the prevailing stereotype that science is "for boys". Conversely, arts and crafts are often considered to be "for girls". Neither is true, of course, and giving students a chance to create and imagine as they learn is a great way to reinforce that. Boys will see how effective these "girly" skills can be for science, and girls will see how brilliant they can be at science.

There is some really compelling research being done at the moment around creativity in education, and how creative practice can improve learning and student engagement. Check out some of the research Cambridge University's Education Department and Lego are doing all around Play.

The following section includes a range of hands-on activities, with differentiated materials, that can help to engage girls in STEM and increase Science Capital. These activities correlate to each chapter in the *Space Diary* and have been developed specifically for girls, but they can of course be used for any students.

ACTIVITY / INVESTIGATING MATERIALS

<http://principiaspacediary.org/activities/investigating-materials/>

This activity asks children to investigate different materials, while they research the best insulator for a spacesuit. Students learn about recording and assessing results, as well as developing graphing skills. Students can investigate three different materials to determine which is most suitable for keeping astronauts safe in extreme temperatures.

ACTIVITY / BUILD YOUR OWN SOYUZ

<http://principiaspacediary.org/activities/build-your-own-soyuz/>

In this activity, students learn about the two parts of the Soyuz and their functions. Students can then make their own Soyuz with either balloons, a UKSA template, or by designing their own and using craft materials. Students can examine images of the Soyuz capsule to determine which materials they should use.

ACTIVITY / CREATE YOUR OWN NEWS REPORT

<http://principiaspacediary.org/activities/create-a-news-report/>

Imagine you are an astronaut. What would you want to tell the world about your experiences in space? And what if you are a journalist? What questions would you ask an astronaut in an interview?

In this activity, students take on the roles of astronaut and journalist, developing questions and answers using the 'Zones of Relevance'. They can then write or record their own interviews. You could even use this activity to develop a class newspaper or journal.

ACTIVITY / BUILD YOUR OWN ISS

<http://principiaspacediary.org/activities/build-your-own-iss/>

This group activity asks students to work in teams, building different components of the ISS which can be joined together to make a complete model.





ACTIVITY / CREATE YOUR OWN SOLAR SYSTEM MODEL

<http://principiaspacediary.org/activities/create-your-own-solar-system-model>

Creating a model of the solar system is a great way to help students learn about the different planets and understand their orbits. This activity provides a range of options for building solar system models, either in groups or individually.

ACTIVITY / SPACE GARDENER – GET OUTSIDE AND GROW!

<http://principiaspacediary.org/activities/space-gardener-get-outside-and-grow/>

Planting seeds and monitoring their growth is not only fun but helps students practise scientific recording. If you have access to a school or community garden, or can set up some planter boxes, challenge your students to grow some of the plants most suitable for gardening in space.

ACTIVITY / MAKE YOUR OWN WATER CYCLE

<http://principiaspacediary.org/activities/make-your-own-water-cycle/>

Tricky concepts like evaporation and condensation are so much easier to understand when you can watch them first-hand. This activity involves a simple experiment which will help student follow and record the water cycle.

ACTIVITY / EGG PARACHUTES

<http://principiaspacediary.org/activities/egg-parachutes/>

Challenge your future engineers! Can your students come up with a parachute design which keeps an egg from cracking when it lands? Provide them with a range of craft materials to see what they can create!

4. ENCOURAGE HOME LEARNING

In my experience of homework, or if you're lucky it might be termed 'home-learning', it is often time-consuming with minimal impact on improving progress or enjoyment. School Policy can also close doors with homework, with schools being over prescriptive and using specific forms or portals to deliver their homework.

However, when done right, home-learning is hugely beneficial, inspiring pupils to explore their own questions and ideas, and giving them opportunities to shine in aspects of creativity and learning that the classroom might not always allow. In science, this is especially important as it encourages students to 'think like a scientist' and recognise that science is all around us in our everyday lives.

For girls, home-learning has an additional benefit. It opens up a dialogue about science with family and friends, giving children a chance to have their achievements acknowledged. If adults can see that a child is being given real and exciting STEM challenges, and tackling them confidently, it paves the way for that child to be encouraged if they choose to pursue a STEM career.

I have found that the best home-learning experiences result from a variety of choice and application. We want to engage parents, as they are our biggest support and resource at increasing engagement and enjoyment, however we do not want them to do the homework either, so providing the right amount of challenge is paramount.

Here are ten home-learning projects that have been very effective. These have been created by myself and my students, with feedback from a range of primary and secondary school teachers.

1. HOMEMADE SOLAR SYSTEM / Create a homemade solar system from items found at home, at thrift shops or at pound stores. To prime students in the classroom, download the Solar System activity from the *Space Diary* here: <http://principiaspacediary.org/activities/the-solar-system/>.

2. DESIGN AND BUILD A SPACE ROBOT / Ask students to research a planet and its conditions, then design a robot to explore this planet. Use the Robots in Space activity as a primer. Download the activity here: <http://principiaspacediary.org/activities/robots-in-space/>

3. DESIGN A ROCKET / Set your class, or whole school, the challenge of designing a balloon or water rocket. Race them as classes and set of the best from each class for a whole school competition. This reduces time used in the classroom as the design process takes place at home.

4. DESIGN A SPACESUIT / Using old clothes or pyjamas, create a spacesuit. Use old cereal boxes for a helmet or oxygen tank, and tubes or toilet rolls for wires. Perhaps all students could then wear these in a space themed mufti day.

5. PLANT A SPACE GARDEN / Give your students a plant pot, lolly stick and seeds to grow at home. They can record their observations at home and bring their plants back in once they are bigger, saving valuable classroom space. <http://principiaspacediary.org/activities/space-gardening/>





6. BAKE SPACE BISCUITS / Bake rocket or planet cakes or cookies. Perhaps these could then be used as a class or school bake-sale, or as a fundraiser for your school charity.

7. OBSERVE THE SKY AT NIGHT / Keep a 'sky at night' journal for a whole week. Write about everything you can see in the sky. You could draw a picture of the moon every night. Does it change over the course of the week?

8. EXPLORE SPACE HISTORY / Find out facts about the space missions. This could include answering questions like: What was the first creature sent into space? Who was the first astronaut? Who was the first person on the moon? Could you display this as a space timeline, perhaps? Download the *Space Diary* 'Making History' activity on page 20.

9. SPACE HEROES / Complete a character study or create a fact file on any of the astronauts you have learnt about, perhaps Tim Peake, Helen Sharman, Samantha Cristoforetti or even Neil Armstrong.

10. SEARCH FOR A SCIENTIST / Ask your students to find a scientist among their family, friends or within the local community and interview them. Think laterally, you never know where scientists are lurking. You can use our "5 minutes with" interview questions (<http://principiaspacediary.org/5-minutes-with-vinita-marwaha-madill-space-operations-engineer-at-the-european-space-agency/>) as a starting point and encourage your students to come up with their own questions.

5. EXPLORE SCIENCE OUTSIDE THE CLASSROOM: MUSEUMS, SCIENCE FESTIVALS AND LIBRARIES

There is nothing better than getting outside and really doing and seeing science in action. Visiting galleries, museums and festivals are exciting opportunities to engage, inspire and increase that Science Capital.

We are aware of the amount of paperwork required to undertake school excursions, or the difficulties if a school is not conveniently located near a place of interest. However, many of these places have websites full of resources and activities for children to try, or forums for asking questions. See Useful Links and Resources on page 30 for lists of our favourite free online galleries.

You can also encourage parents to take their children to these places. Some parents may not usually visit a museum themselves, and may feel intimidated, so you could give them a mission to undertake as a family (perhaps a different mission each term?). For example, task them to find the oldest artefact in a local museum and draw a picture of it. Send this home with a list of local attractions, like the local planetarium, dinosaur museum, National Trust site or local nature reserve, as well as some national locations. You never know when families might next be visiting somewhere interesting and if they have a mission to accomplish together they may well put the nearest science museum on their itinerary.

And don't forget your local libraries. These are often the hidden gems when it comes to knowledge and discovery. If we can get students reading and even exploring more non-fiction, we can open doors through their imaginations.

Find your local library: <https://www.gov.uk/local-library-services>

Useful Links and Resources

FREE TEACHING RESOURCES

All of the Space Diary activities in this booklet are available to download for free, along with teaching notes, lesson plans and curriculum links. Download activities at: principiaspacediary.org/activities

principia MISSION SPACE DIARY



RESEARCH AND STATISTICS

This book has been developed by combining relevant research and pedagogical studies with actual classroom experience. It is not intended to be a definitive guide to the complex topic of gender but rather a practical guide for teachers and one that will continue to evolve.

If you would like to learn more, these links are just a few of the resources available. If you'd like to suggest additions please feel free to email us at info@curvedhousekids.com.

Watch an introduction to Science Capital here: <https://youtu.be/A0t70bwPD6Y> and read more on the Kings College London website: <http://www.kcl.ac.uk/sspp/departments/education/research/Research-Centres/cpr/Research/currentpro/Enterprising-Science/01Science-Capital.aspx>

Women and science careers: Leaky pipeline or gender filter? by Jacob Clark Blickenstaff <http://www.tandfonline.com/doi/pdf/10.1080/09540250500145072>

WISE, a campaign to promote women in science, engineering and technology <https://www.wisecampaign.org.uk/>

STEMettes, a social enterprise supporting young women in STEM in the UK and Ireland www.stemettes.org

SciGirlsSeven, seven proven strategies for engaging girls in STEM from the US TV Programme SciGirls http://tpt.vo.llnwd.net/o26/scigirls/ScigirlsSeven_Print.pdf

National Girls Collaborative Project (US), Tips for Engaging Girls in STEM <https://ngcproject.org/engaging-girls-stem>

Maximising Women's Contribution to Future Economic Growth, published by the Women's Council, Department for Culture, Media & Sport (2015) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/456420/DfE_WBC_Two_years_on_report_update_AW_CC.pdf

WEBSITES AND RESOURCE PORTALS

Principia Space Diary website and resource portal

[http:// principiaspacediary.org](http://principiaspacediary.org)

Principia Education Website

<https://principia.org.uk/>

ESA Kids Club

<http://www.esa.int/esaKIDSen/>

Explore with Paxi

http://www.esa.int/esaKIDSen/SEMBIKQ982I_OurUniverse_0.html

Mission X: Train Like an Astronaut

<http://trainlikeanastronaut.org/>

A Day in the Life of an Astronaut: Life on Board the ISS

<https://www.nasa.gov/audience/foreducators/stem-on-station/dayinthelife>

NASA Kids Club

<https://www.nasa.gov/kidsclub/index.h>

PROGRAMMES TO WATCH

The RI Christmas Lectures

<http://www.rigb.org/christmas-lectures/watch>

BBC Horizon

<http://www.bbc.co.uk/programmes/b006mgxf>

Tim Peake 'How to be an Astronaut'

<http://www.bbc.co.uk/programmes/p0327fp0/clips>

Wonders of the Universe

<http://www.bbc.co.uk/programmes/b00zdhtg/clips>

SPACE CAREERS

<https://www.stem.org.uk/elibrary/resource/35260>

If you want to explore careers even further, get a copy of 'Look to the Future: the Future Needs STEM'. This is a free downloadable booklet focusing on a range of activities aimed at raising aspiration and understanding of career pathways in STEM and space, created by the National STEM Learning Centre.



<http://www.destination-space.uk/meet-space-crew/find-your-role-space-crew/>
Destination Space has a fun, online quiz children can take to discover the role that would best suit their interests and personality.

<http://www.stemnet.org.uk/educators/>

Sign up for STEM Ambassadors to visit your school. This free service connects you with STEM graduates and those with STEM careers, to run STEM clubs or to provide talks or activities in your school. Research shows that 49% of pupils who have had contact with a STEM Ambassador and 61% of STEM Club members want a job that involves STEM, compared to 37% of all pupils who had not had these opportunities.

<https://www.stem.org.uk/elibrary/resource/32016>

This website contains a range of fact files, videos and resources that are free and downloadable, all about different roles that space scientists and engineers play in getting Tim to the ISS and back safely.

<https://www.stem.org.uk/elibrary/collection/3730>

The Centre for Industry Education Collaboration (CIEC) produces classroom resources and teacher guidance to help highlight the links between classroom science and science-based industry. You can get involved in this project and visit real locations and sites with follow up activities. It also offers opportunities for real scientists and engineers to visit your school.

<https://www.stem.org.uk/elibrary/collection/3572?page=1>

More careers videos, fact files and interviews of a range of British Space scientists and engineers.

<http://astroacademy.org.uk/>

The Tim Peake Astro Academy provides a range of easy to watch and understand videos and research on careers and space related themes.

<http://www.rigb.org/christmas-lectures/teaching-resources/2015-how-to-survive-in-space>

The Royal Institution Christmas Lectures covered 'How to Survive in Space' – covering all aspects from launch, to living on board the ISS, to getting home safely. Primary resources and videos are available here and link nicely to all chapters of the *Space Diary*.

<https://usborne.com/browse-books/catalogue/product/1/9031/the-usborne-mini-astronaut39s-handbook>

The Mini Astronauts Handbook, written by Louie Stowell – another awesome female space expert – is free to all! You can download this free on any platform, including Amazon. A great idea to send home to parents to encourage reading at home and interest in space and STEM related careers.

<http://www.wherestemcantakeyou.com/>

An online resource full of career profiles. This is created by Rolls Royce and uses them as a lot of case studies. It contains a really easy to use 'go create' section where students can create news reports, posters and job adverts online. It also has really easy to use and adapt teacher notes.

The Principia Space Diary is a STEM-literacy resource for UK primary schools, developed by Curved House Kids and author Lucy Hawking. It is designed to engage students in science by learning about the 2015-16 space mission of European Space Agency Astronaut Tim Peake. Over 60 hours of lessons plus videos and teaching resources are available free at www.principiaspacediary.org.

We are extremely grateful for the support of the UK Space Agency, without whom the Space Diary would not be possible, and for additional support from the European Space Agency and Professor Peter McOwan at Queen Mary University of London.

First published in 2017 by
Curved House Kids Ltd
60 Farringdon Road
London EC1R 3GA
www.curvedhousekids.com
info@curvedhousekids.com

Written by Kristen Harrison and Claire Loizos
Designed by Kristi Korotash and Alice Connew
Edited by Lucie Stevens

Copyright Notice

The text within this document may be shared and republished for non-commercial purposes under the Creative Commons Non-Commercial 4.0 license. <https://creativecommons.org/licenses/by-nc/4.0/>



Images are copyright to their original source. Please contact the source directly for permission to reproduce.

Front and back cover images © Sarah Winborn
Image on page 4 © Christopher Ison for University of Portsmouth
Image on page 6 © Sarah Winborn
Image on page 7 © The WISE Campaign, 2016
Images on pages 9, 10, 23, 24, 28 © Claire Loizos
Image on page 12 © Michael Cockerham
Images on pages 16, 33 © Max Alexander, UK Space Agency
Images on pages 19, 27 © Tim Peake, European Space Agency

HOW DO WE HELP GIRLS SEE THEMSELVES AS SCIENTISTS?

The lack of diversity in the sciences is estimated to cost the UK £2bn a year. Meanwhile, we have 50,000 girls a year who are not choosing STEM careers, but who have all the smarts to succeed in science.

Inspired by Space: Engaging Girls in STEM is a guide for primary teachers and educators to help you not only engage your students in learning but also help embed a lasting interest in science, technology, engineering and maths. Teacher Claire Loizos and educational publisher Kristen Harrison offer five simple strategies to help girls succeed in STEM, including harnessing skills like communication, collaboration and creativity.