

Science

Monday 28 July: Cosmetic chemistry

Age: 7–10, Time: 11am–3pm

Tickets: £30/£25 Faraday

Students will investigate acids and alkalis and how they neutralise each other by forming a salt. They will also observe the properties of oils and waxes and how they are able to dissolve into one another. These processes will help us to understand the manufacture of cosmetics such as bath bombs and lip balms.

Tuesday 29 July: Magnets, motors and generators

Age: 11–14, Time: 11am–3pm

Tickets: £30/£25 Faraday

In this workshop, set in a historical context, students will undertake a series of hands-on activities to understand how magnetism and electricity are linked and the important electromagnetic principles which drive our modern world. Students will see how liquids can be magnetised, build an electromagnet, and construct two types of motor.



Wednesday 30 July: A question of taste

Age: 16–18, Time: 10am–4pm

Tickets: £35/£30 Faraday

In this genetics workshop, students will test their ability to taste a bitter chemical found in broccoli and Brussels sprouts (PTC). Once they have discovered their phenotype, they will extract their own DNA and use modern techniques to discover their genotype. This workshop was developed to mark Darwin's 200th birthday in 2009.

Thursday 31 July: Forensics

Age: 14–18, Time: 11am–3pm

Tickets: £30/£25 Faraday

During this workshop students will investigate a fictional crime scene using modern molecular biological techniques including restriction digests and gel electrophoresis, and discuss the skills required in Forensic Science. This workshop introduces processes that many students do not have practical exposure to before attending university.

Friday 1 August: Spectacular colour chemistry

Age: 11–14, Time: 11am–3pm

Tickets: £30/£25 Faraday

In this workshop students will discover what a colour actually is, understand how objects become coloured, and how chemists can manipulate these aspects to produce both natural and synthetic dyes. Students will synthesise a natural dye and investigate colour mixing.

Monday 4 August: Gene jewellery – extract your own DNA

Age: 7–9, Time: 11am–1pm, Age: 10–12, Time: 2pm–4pm

Tickets: £25/£20 Faraday

Students will extract their own DNA and walk away with a small piece of it in a necklace for them to wear. This workshop is a great introduction to enzymes, DNA structure and uses equipment usually found at university.

Tuesday 5 August: Bacterial evolution

Age: 14–18, Time: 11am–3pm

Tickets: £30/£25 Faraday

The continual struggle between bacterial pathogens and their hosts provides an illustration of evolution in action, driven by changes in the bacterial DNA. Students will analyse bacterial DNA and decide what advice to give their colleagues at the scene of an unknown outbreak. They will also decide whether their samples need further investigation.

Wednesday 6 August: Spectacular colour chemistry

Age: 14–18, Time: 11am–3pm

Tickets: £30/£25 Faraday

In this workshop students will discover what a colour actually is, understand how objects become coloured, and how chemists can manipulate these aspects to produce both natural and synthetic dyes. Students will solve a real life chemistry problem.

Thursday 7 August: Cosmetic chemistry

Age: 7–10, Time: 11am–3pm

Tickets: £30/£25 Faraday

Students will investigate acids and alkalis and how they neutralise each other by forming a salt. They will also observe the properties of oils and waxes and how they are able to dissolve into one another. These processes will help us to understand the manufacture of cosmetics such as bath bombs and lip balms.

Friday 8 August: Crash testing; high-velocity eggsporter

Age: 11–14, Time: 11am–3pm

Tickets: £30/£25 Faraday

In this workshop students will build and crash test a vehicle on a specially designed rig. They will then redesign and build their own model car with the aim of keeping their egg passenger alive! This workshop was developed with Dinovis of the Transport Research Laboratory (TRL).



The Royal Institution
Science Lives Here

July–August 2014

Summer Schools



Science on demand

Catch up with the latest Ri events, your favourite CHRISTMAS LECTURES and the best science videos from across the web on the Ri Channel www.richannel.org.

Faraday Museum

Explore the world-changing science that's happened at the Ri since 1799. From Faraday's original 1850s laboratory and the first electric motor to Davy's miners' lamp, everywhere you look you'll discover something amazing! Come for an hour or grab an eGuide and spend a whole afternoon.

Free admission.

Become a Member

Join the Ri to receive enormous value with free access to all Ri public events (excluding some premium events and the CHRISTMAS LECTURES), members only events and the exclusive opportunity to enter the ballot for CHRISTMAS LECTURES tickets. More information at www.rigb.org/membership. Faraday members also receive discounted places for Ri Summer Schools.

More information

Please check the Ri's online What's On calendar for more details about each event, including details on what to bring to each session and information on lunch breaks. Please note that when a lunch break is included in a workshop, students will need to bring a packed lunch and a drink and some of these breaks will be unsupervised. Please check the age criteria carefully before booking your events as we cannot accept students who are younger or older than the age specified.

Financial assistance

The Potential Trust may be able to offer financial assistance to enable children to participate in Ri events and activities if this would otherwise be difficult. Please contact Anna Comino-James on 01844 351666 or email her at thepotentialtrust@gmail.com.

Ticket booking information

Book online at www.rigb.org or call +44 (0)20 7409 2992
9.00am – 6.00pm Monday to Friday

Royal Institution open
9.00am – 6.00pm Monday to Friday
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Ri Channel www.richannel.org

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Front cover image: Tim Mitchell

Mathematics

Thursday 24 July: Climate change, does it all add up?

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

Climate change is potentially one of the greatest threats that our world faces today. In this workshop with **Chris Budd**, students will have the chance to get to grips with the climate change debate, use mathematics to predict climate changes and work out how reliable these predictions can be.

Monday 28 July – **CREST accredited**

Friday 1 August: Computer-based mathematics

Age: 16–18, Time: 10am–4pm daily
Tickets: £250/£225 Faraday

This week-long Summer School will introduce students to the use of computing in exploring mathematical ideas. **David Vaccaro** will teach them the basics of Wolfram Mathematica before challenging them to produce their own project, working individually or in small groups to research and investigate a problem of their choice.

Tuesday 29 July: Number bases

Age: 7–9, Time: 10am–12:30pm
Tickets: £25/£22.50 Faraday

The 1,2,3 system we use to write down numbers is called ‘base 10’. But what exactly is a base? And what other bases are there? In this workshop with **Andrew Jeffrey** students will try fun practical activities that will help them to appreciate number bases, understand our own base 10 and work with binary.

Tuesday 29 July: Curves and lines

Age: 10–12, Time: 1:30pm–4pm
Tickets: £25/£22.50 Faraday

What does a football have in common with a fountain? How can straight lines create curves? **Georgina Nutton** will help students find answers to these questions in this workshop. They will have the opportunity to investigate curves both mathematically and creatively, discovering some of the hidden beauty within mathematics.

Thursday 31 July: Codes and ciphers

Age/time: 7–9 year-olds from 10am–12:30pm,
10–12 year-olds from 1:30pm–4pm
Tickets: £25/£22.50 Faraday

Codes and ciphers have been used for hundreds of years to keep messages secret. In this workshop with **Jenny Sharp**, students will investigate codes and ciphers through the ages. They will learn how to write and decrypt secret messages using methods from the ancient Spartans through to the 21st century.

Monday 4 August: The story of π

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

In this workshop with **Alan Davies**, students will follow in Archimedes’s footsteps and study π , obtaining approximations, exploring our number system and investigating whether the decimal expansion of this fascinating number is truly random. They will develop solutions to a wide variety of problems and will see that π crops up in some unexpected places.



Image credit: Tim Mitchell

Wednesday 6 August: The mystery of numbers

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

The first mathematics we learn has to do with numbers. But numbers are also one of the most mysterious things we study. In this workshop with **Phil Ramsden**, students will look at taming very large numbers, explore deep connections between separate areas of mathematics and ask the question “How many numbers are there?”

Friday 8 August: Knots and links

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

Knots have existed for thousands of years in art, religion, climbing, sailing and fishing. When did they become a part of mathematics, and why? Students will explore different questions in Knot Theory with **Julia Collins** (many of which are still unresolved), and will see why these questions are becoming very important.

Monday 11 August: The mathematics of musical instruments

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

Mathematics has a very important role to play in understanding music and how sound is created in different musical instruments. With **Russell Crann**, students will explore musical pitch and harmonics. They will then put theory into practice by making their own musical instruments and creating music out of mathematics.

Monday 18 August: Tiling in two and three dimensions

Age/time: 7–9 year-olds from 10am–12:30pm,
10–12 year-olds from 1:30pm–4pm
Tickets: £25/£22.50 Faraday

Students will explore tilings, proof and polygons in this hands-on workshop with **Amy Hooker**. They will investigate the many ways in which two-dimensional shapes fit together, making and testing predictions and discovering more about the properties of familiar shapes. They will also use shapes to explore the concept of mathematical proof.

Tuesday 19 August: How big is the universe?

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

In this workshop **Martin Yates** will use mathematics to try to understand how the universe works. Students will explore a number of mathematical techniques that astronomers employ, modelling everything from the size and history of galaxies to the probability that you might one day communicate with civilisations from another planet.

Wednesday 20 August: Thousands of years of mathematical stories

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

In this workshop students will explore our mathematical heritage, looking at the stories of mathematics from various cultures. **Ioanna Georgiou** will travel from pre-historic times to ancient Greek and Hindu-Arabic mathematics and all the way up to the modern day, exploring some of the mathematical ideas which changed our world.

Thursday 21 August: Mathematical origami

Age/time: 7–9 year-olds from 10am–12:30pm
10–12 year-olds from 1:30pm–4pm
Tickets: £25/£22.50 Faraday

There are many interesting mathematical shapes that can be made using paper or card. With **Katie Steckles**, students will look at some fabulous objects they’ve never seen before and have a go at building them – using their mathematical thinking skills to work out where everything goes!

Friday 22 August: Mathematical puzzles and problem-solving

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

One of the main skills you develop when you do mathematics is the ability to solve problems. **Katie Steckles** will introduce students to a range of puzzles, including some famous problems mathematicians are still stuck on. They will use their problem-solving skills to work out how to build mathematical curiosities and mind-bending fractals.

Engineering

Monday 28 July: Piling on the foundations

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

In this workshop with **Tina Patel**, students will find out how engineers keep our heaviest buildings standing and all of the extra considerations involved, from the scientific principles to the medical issues. They will make their own concrete pilings, testing their load-bearing capabilities and exploring how concrete foundations can be improved.

Wednesday 30 July: Shake, rattle and roll

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

We hear about earthquakes and the devastation they cause in other countries. But how do we know where they have hit or determine their severity? In this workshop with **Steve Kane**, students will explore the mathematics behind earthquakes and will compete to build and test the most effective earthquake-proof structures.

Friday 1 August: It’s not rocket science

Age/time: 7–9 year-olds from 10am–12:30pm,
10–12 year-olds from 1:30pm–4pm
Tickets: £25/£22.50 Faraday

Have you ever wanted to build a rocket? **Vicki Lonnon** will show you the basics in this workshop, from rocket science to lift-off and the challenges you can face along the way. Students will investigate rocket engineering from the initial design through to making and testing their own rockets.

Tuesday 5 August: Building bridges

Age/time: 7–9 year-olds from 10am–12:30pm,
10–12 year-olds from 1:30pm–4pm
Tickets: £25/£22.50 Faraday

People and animals have crossed rivers and gorges for thousands of years. From stone slabs and rope bridges to amazing modern bridges, they basically have the same idea – to provide a safe crossing. **Alan Davies** will explore different types of bridges in this workshop where students will design, construct and test their own.

Thursday 7 August: Weapons of math instruction

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

In engineering you need to have accurate designs and monitor ongoing processes carefully. In this workshop, students will work with **Paul Hewson** to evaluate the effectiveness of small catapults using a few analytic rules. They will compete in groups to optimise the catapults’ performance to make the most accurate weapon of math instruction.

Monday 11 – **CREST accredited**

Friday 15 August: Introduction to robotics

Age: 14–17, Time: 10am–4pm daily
Tickets: £250/£225 Faraday

Students will design and build specialised robots in this week-long Summer School. **Rustam Stolkin** will teach the engineering principles and practical considerations of robotic design before students work together in groups to create an underwater retrieval robot and a sensor-controlled autonomous robot, considering real-world applications and presenting their products to the group.

Monday 18 August: The power of process

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

What does it take to get a brilliant idea to the market? In this workshop with **Mairi Macintyre**, students will work in groups to meet a project specification, learning that any new product development and launch involves a range of design and management skills and how to make each product launch better.

Tuesday 19 August: Acoustics – loudspeakers and Helmholtz resonators

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

Acoustic devices are all around us, from loudspeakers to automotive exhausts, all with very different design outcomes. In this workshop with **Jon Constable**, students will explore two simple concepts that underpin modern acoustic theories. They will discover the science behind loudspeakers and Helmholtz resonators before constructing a working speaker from household materials.

Wednesday 20 August: Dem Bones

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

In this workshop, **Andrew Phillips** will take students on a journey into the world of biomechanics, exploring the forces, moments, stresses and strains involved in how we move and the latest research on replacing our joints. Students will build and test life-sized artificial hip joints to discover the science behind replicating our skeleton.

Thursday 21 August: Crash testing

Age/time: 7–9 year-olds from 10am–12:30pm,
10–12 year-olds from 1:30pm–4pm
Tickets: £25/£22.50 Faraday

Explore the science of car crashes with **Dinos Visvikis**. Students will find out how car designers apply the laws of physics to help protect passengers, before working in groups to improve the design of a basic car. Whose will win in the competition for safest design?



Image credit: Tim Mitchell

Friday 22 August: Engineering arches

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

In structures all around us we see arches of different styles and shapes. From simple starting points of line-art and paper chains, students will explore the essential mathematical and physical aspects of parabolas and catenaries with **Bill Tucker**, before taking on the challenge of building their own free-standing arches.

Computer Science

Monday 4 August: Coding from Scratch

Age: 7–9, Time: 10am–12:30pm
Tickets: £25/£22.50 Faraday

We use computers to play games, solve problems and communicate, and computer animation is everywhere. But how do you get started with programming? **David Nutting** will help students to explore the very basics of coding with the program Scratch, using graphics to help develop their ideas into real, working computer programs.

Monday 4 August: Puzzles, mazes, turtles and shapes

Age: 10–12, Time: 1:30pm–4pm
Tickets: £25/£22.50 Faraday

The computer program has changed the films we watch, the way we communicate and the way we solve problems. In this workshop with **David Nutting** students will use Blockly to play with puzzles, mazes and turtles, explore computational thinking and have a go at the basics of creating and manipulating computer graphics.

Tuesday 5 August: Hands-on 3D printing

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

Some of the latest developments in fashion design, film props and automotive and aerospace engineering are achieved using the 3D printer. In this exciting workshop with **Chris Bradley** and **Stan McCarthy**, students will get a chance to try it for themselves, producing a design and printing their own 3D objects.

Wednesday 6 August: 3D printing and design

Age: 16–18, Time: 10am–4pm,
Tickets: £50/£45 Faraday

3D printing is at the heart of cutting-edge design and manufacturing, used in everything from fashion to film props to racing cars. Students will explore this fascinating process with **Stan McCarthy** and **Chris Bradley**, developing their own unique designs from concept to the final program and creating an original 3D printed object.

Thursday 7 August: Byte-sized computing

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

Underlying every kind of computing system, from mobile phones to the internet, is the computer program. **David Nutting** will demonstrate a range of programming tools in this workshop, including Blockly, Khan Academy and JavaScript. Students will explore computer graphics, how codes and ciphers are used in the internet and why they matter.

Tuesday 12 August: How networks rule the world

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

Networks underlie the world around us, from travel to social networks. **Harriet Mills** and **Nick Fyson** will use network theory to predict the spread of an infectious disease and prevent an epidemic. Students will model disease transmission, the effect of vaccination and how far and fast an epidemic will spread.

Wednesday 13 August: Illuminating engineering

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

Modern day manufacturing links together art, science, engineering and technology in order to create new, exciting and bespoke products. With **Margaret Low** and **Simon Leigh** students will explore this through the design and manufacture of a bespoke, interactive lamp, writing the lamp control software and producing a personalised lamp shade using digital manufacturing tools.

Thursday 14 August: Puzzles, mazes and turtles

Age: 7–9, Time: 10am–12:30pm
Tickets: £25/£22.50 Faraday

The computer program has revolutionised the films we watch, the way we communicate and the way we solve problems. Working with **David Nutting**, students will use Blockly to play with puzzles, mazes and turtles, get creative and have a go at solving some problems using this fun and friendly computer program.

Thursday 14 August: Coding for the web

Age: 10–12, Time: 1:30pm–4pm
Tickets: £25/£22.50 Faraday

Computer programs control our phones, our traffic systems, our televisions and our games. **David Nutting** will help students to get to grips with Khan Academy, an easy introduction to JavaScript – the programming language used across the internet. They will explore some existing computer programs and get started with developing their own.

Friday 15 August: Programming in C# for beginners

Age: 13–15, Time: 10am–3pm
Tickets: £50/£45 Faraday

Mathematicians use computers to help solve the most complicated problems. In this workshop with **Paul Hall**, aimed at those with no experience of the programming language C#, students will explore how computers can be used to do mathematics as they learn how to program simple games and solve a variety of problems.

Monday 18 August: Programming the web

Age: 16–18, Time: 10am–4pm
Tickets: £50/£45 Faraday

In this workshop with **David Nutting**, students will explore how to program the internet. Moving from algorithms and logic to codes and graphics to writing working web code, students will explore the basics of producing a usable computer program and the nuts and bolts of how the internet and networks function.