IOP | Institute of Physics
Education *Supporting Teachers*

Classroomphysics

The newsletter for affiliated schools

March 2015 Issue 32

New resource

Use far-off worlds to inspire students

The search for Earth-like planets orbiting other stars offers fascinating possibilities for the existence of life elsewhere in the universe. One intriguing example is the discovery of five rocky exoplanets around the star Kepler-444 by a team led by Dr Campante of the University of Birmingham. As he explains: "These planets were formed more than 11 billion years ago, making this system more than twice as old as our solar system. Although these planets are too close to its star to support life as we know it, their discovery does seem to indicate that Earth-size planets have formed throughout most of the universe's 13.8-billion-year history – leaving open the possibility for the existence of ancient life in the galaxy."

To help bring the new and exciting area of exoplanet research into the classroom, the Institute has developed *Exoplanet Physics*, a set of five curriculum-linked practical activities matched to the 11–14 curriculum. Affiliated schools will receive a copy with this issue of *Classroom Physics*.

Each of the five stand-alone activities can be used in a lesson or as part of a science club. They suggest extension work and include a "Taking It Further" section to allow students to build on what they have learnt through independent research. Each activity can be used individually, or in combination, as the basis for a CREST Award (an enrichment scheme run by the British Science Association). One "pick-up and run" CREST research project idea is included in the publication and another is included as a teaching tip on page 8 of this newsletter.

An ideal opportunity to introduce the first activity (The Transit Method) is on 20 March; on that morning, a partial solar eclipse will be observable (weather permitting) across the UK. See the insert included with this newsletter for some ideas for viewing the solar eclipse safely. Build on eclipse observations by discussing planetary transits in the solar system (e.g. the transit of Venus), then transits in other star systems and how we use them to detect exoplanets.

The table below shows how the activities fit in with the English Key Stage 3 curriculum.

Tiago Campante/Peter Devine

Kepler-444 hosts five Earth-sized planets in very compact orbits. The planets were detected from the dimming that occurs when they transit their parent star, as shown in this artist's conception.

For more information: and to download *Exoplanet Physics* and extension ideas visit iop.org/exoplanets. For more about CREST, see britishscienceassociation.org/crest. Students can hunt for exoplanets at www.planethunters.org.

Key Stage 3 Curriculum Links for *Exoplanet Physics*	
Activity 1: The Transit Method	Light waves: students learn about the ray model of light, how shadows are formed, and how light waves travel through a vacuum.
	Space physics: students learn about the Sun, stars and galaxies, and about the Earth as a planet.
Activity 2: The Habitable Zone	Energy changes and transfers: students learn about energy transfers by radiation, due to temperature differences.
	Changes in systems: students learn about changes in amounts of energy associated with temperature.
	Space physics: students learn about the Sun as a star, and about the Earth as a planet.
Activity 3: Exoplanet Atmospheres	Light waves: students learn about the transmission and absorption of light by materials, and about the colours and the different frequencies of light and differential colour effects in absorption.
	Space physics: students learn about the Sun, stars and galaxies, and about the Earth as a planet.
Activity 4: Planet Density	Physical changes: students learn about similarities and differences, including density differences, between solids, liquids and gases.
	Space physics: students learn about the Earth as a planet.
Activity 5: Day and Night, Seasons	Space physics: students learn about seasons and day length on the Earth.

The latest physics education news, resources and classroom ideas – from the IOP education team

In this issue

Editorial

Welcome to the spring edition of *Classroom Physics*.

Affiliated schools and colleges will have received a copy of the latest IOP publication *Exoplanet Physics*. Armed with this resource, along with the various teaching tips featured in this newsletter (see insert and page 8) you should have plenty of material to support classroom activity around the solar eclipse that will happen on 20 March.

A seminar was held last November to discuss engagement with physics by students from groups with the lowest socio-economic status. At the same time, the IOP launched two new reports: *Raising Aspirations in Physics* and *Opportunities from Physics*. See page 3 for more details of these two reports and for information on the pilot projects we carried out with two schools.

The Institute organises some of the largest day-meetings for the physics teaching community in the UK and Ireland, including the Rugby Meeting in June (details can be found in the flyer sent out to affiliated schools). For details of IOP-organised meetings coming up in the next few months, see the events page on page 7, or take a look at the education calendar on the IOP website via iop.org/education for the most up-to-date list of meetings.

We have marked the start of the International Year of Light (page 6) with a special edition of the Marvin and Milo activity cards, which have been sent out with this newsletter to our affiliated schools and colleges.

If you would like further copies of any of the IOP resources or reports featured in this newsletter, please send your request to education@iop.org. Feedback on any aspect of the affiliation scheme or the general support we offer schools and colleges are always appreciated.

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Professional development

Get chartered with the IOP

IOP

We are encouraging physics teachers, like other professionals, to become chartered physicists.

Becoming a chartered physicist with the Institute of Physics shows that you have reached the highest standards in your chosen discipline.

There is no question that physics teachers are doing physics. As well as doing the work of physics and securing its future (by developing the next generation of physicists), teachers are also doing physics in a very real sense: good teachers can spend much of their time contemplating and developing the descriptions and narratives of the discipline, thereby improving and deepening our collective understanding of the physical world and the models we use to describe it.

Suitable for those with masters-level qualifications in physics (there are ways to demonstrate equivalence) working at a responsible level in a relevant area, Chartered Physicist is the Institute's own title – it cannot be obtained anywhere else. It is aimed at practising physicists who have a breadth of competence and can demonstrate that they are working at a responsible level (recognising the diversity of roles that this might encompass).

So, if you are a teacher and thought that chartering was for those outside teaching, please think again. We would be delighted to receive your application and can offer specific guidance on how to fulfil the criteria using your professional experience and contributions to physics through teaching.

For more information: on gaining chartered status and to apply online, visit iop.org/membership.

Professional development

Cash award supports physics teaching ideas

Do you have an idea about physics teaching that you have always wanted to develop? The Anthony Waterhouse Fellowship could help bring the idea to fruition. The Fellowship provides an award of up to £2,000 to buy materials, software or services to help develop a teaching idea into something that other physics teachers can use.

Projects such as developing a cost-effective interface for recording and making sounds using a computer have been supported in the past. The purpose of this work was to investigate ways in which everyday computers could be used in schools to fulfil several of the roles of more expensive, specialised laboratory equipment for teaching and learning purposes.

Another recipient of the Fellowship has used the award to conduct research into perceptions of practical work and whether views differed between male and female students.

Stuart St John, a past recipient of the Fellowship, said: "I was able to spend time on developing these ideas thanks to the Anthony Waterhouse Fellowship awarded by the Institute of Physics from the Trust set up in Anthony's name. I am grateful to the Trust and the Institute for this opportunity."

IOP

The Anthony Waterhouse Fellowship seeks to support your physics education research projects.

For more information: and to apply, visit iop.org/waterhousefellowship.

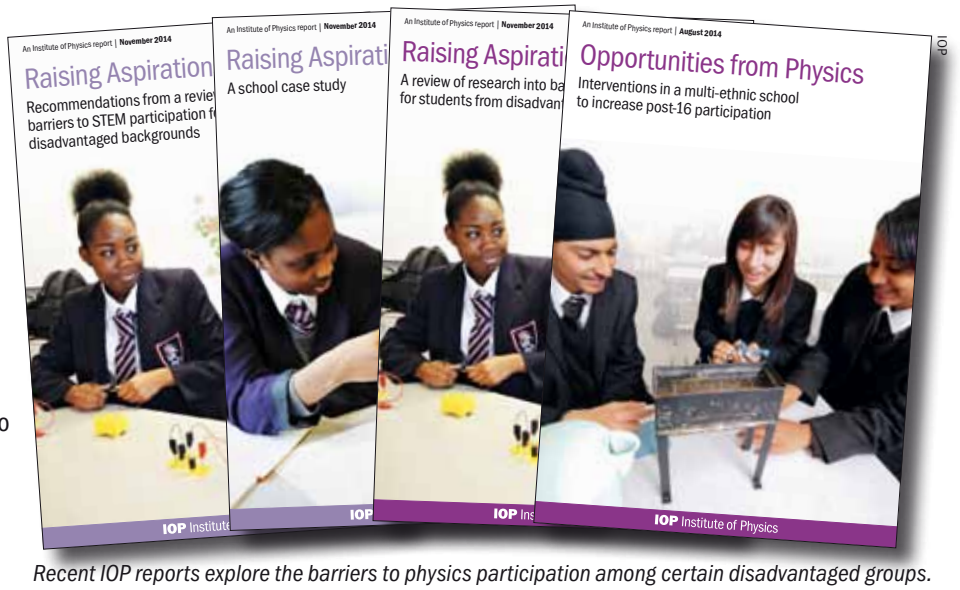
Reports

IOP seminar highlights how disadvantaged groups are deterred from physics

Young people in England from groups with the lowest socio-economic status (SES) are far less likely than their peers to study and succeed in physics at A-level or physical sciences at university, but secondary schools can make a crucial difference, an audience convened by the IOP was told.

At a seminar in London last November, held to discuss raising aspirations in physics, attendees from the education sector, business, charities and learned societies were presented with stark data showing that while more than half of 18–19-year-olds in the highest SES group go to university, less than a fifth in the lowest SES group do so. Presenting the figures, Institute for Fiscal Studies research fellow Claire Crawford showed that the pattern was similar for participation in the physical sciences at university. In addition, those in the most advantaged group are also eight times more likely to take physics A-level than the least advantaged, and 20 times more likely to get an A grade or higher in physics A-level. Those in the highest SES group are also more likely to go to a prestigious Russell Group institution.

Two reports on small-scale pilot projects with individual schools were also launched at the event. *Raising Aspirations in Physics* was a three-year pilot study at a school in the northeast investigating the barriers to participation in physics post-16 and the effectiveness of some interventions.



IOP

Recent IOP reports explore the barriers to physics participation among certain disadvantaged groups.

The factors affecting low SES groups are numerous and include: low "science capital" – the awareness of science and its importance within a family; parental understanding of the university system and routes through education; sibling and parental attitudes; literacy and numeracy skills; self-confidence and social confidence; timetabling by schools; staff turnover; and the setting of year groups, which can reinforce the impression that children from low SES groups are less able.

Opportunities from Physics reports on interventions in a multi-ethnic school to increase post-16 participation in physics. Parents had very high aspirations for their children but almost no understanding of how the university system works. The interventions that took place with a cohort of triple science GCSE students and their parents focused on showing the pathways from physics that could lead to a wide range of secure and satisfying careers – not just medicine or pharmacy.

For more information: visit www.iop.org/publications and click on 2014, where you will find all four publications.

Resource

New website helps engage girls with physics

Are you struggling to engage girls in physics in the classroom? Girl-Friendly Physics, a website produced by WISE in partnership with Intel and the Institute of Physics, may help. It is a fantastic resource where teachers can find tips, hints and resources on how to create a better experience in the classroom for girls. The aim is to help teachers to encourage girls to enjoy physics more, to encourage girls to study physics after 16+ and follow careers using physics and maths.

Teachers can assess their teaching style using a checklist to find out if it is girl-friendly. This is an opportunity to be honest and see if there is any unconscious bias creeping into the classroom; there are tips and hints offered on ways to make slight changes to have a greater impact.

A list of the top ten inventions by women help bring science to life, and there are links to recent studies that teachers will find extremely helpful and insightful.

WISE

Could your teaching be more girl-friendly? The new website will help improve your approach.

For more information: to see the new website and explore the resources, visit www.girlfriendlyphysics.co.uk.

Report

STEM: Not for people like me?

SEPnet

In a report for WISE (Women in to Science and Engineering), sponsored by Network Rail, Prof. Averil Macdonald explains why STEM outreach and engagement activities have a limited impact on girls and other young people who are under-represented in the STEM workforce. The report recommends a fresh approach: focusing on the types of people who succeed in science, technology and engineering, using adjectives to describe their personalities and aptitudes, rather than the jobs themselves.

Prof. Macdonald concludes that when it comes to encouraging women into science, technology and engineering, we just haven't got the messaging right. Most girls decide that jobs and careers in science are "not for people like me".

The report suggests that the answer is to enable girls to resolve the conflict between their self-identity and their perception of the STEM-identity (which is not girl-friendly), which prevents many girls from choosing physics. In particular, when talking about careers we should describe the "person spec" – aptitudes (using adjectives) – as well as the "job spec" (using verbs).

The "Science: it's a people thing" workshop for girls seeks to address some of these issues: www.iop.org/girlsinphysics.

For more information: and to download the report, visit www.wisecampaign.org.uk/education/not-for-people-like-me. Blogs discussing the report are at www.internationalinnovation.com/not-for-people-like-me and www.ncub.co.uk/blog/stem-identity.html.

Event

Come and be illuminated by Science on Stage

Are you looking for an exciting ideas-packed opportunity for CPD? Need some help with practicals? Want to build cross-curricular work into your classroom? Or do you fancy starting collaborations with teachers from another country?

Science on Stage, the international festival of science teaching, is coming to the UK. From 17–20 June 2015, 350 primary and secondary school teachers from all over Europe and Canada will be buzzing around in London.

Under the motto "Illuminating Science Education", teachers will come together to enthuse each other, sharing experiments and teaching ideas for science, technology and mathematics education as part of the hands-on fair of activities, with some being selected to provide workshops, seminars and on-stage performances.

Science on Stage UK is hosting the festival in the People's Palace at Queen Mary University of London, in the heart of London's vibrant East End. The participating teachers were selected in 2014 through competitive national activities in 25 countries, but anyone can attend the open day on 19 June.

For more information: visit scienceonstage@qmul.ac.uk. Tickets are £10 and to book your place go to goo.gl/1Fe9kW.

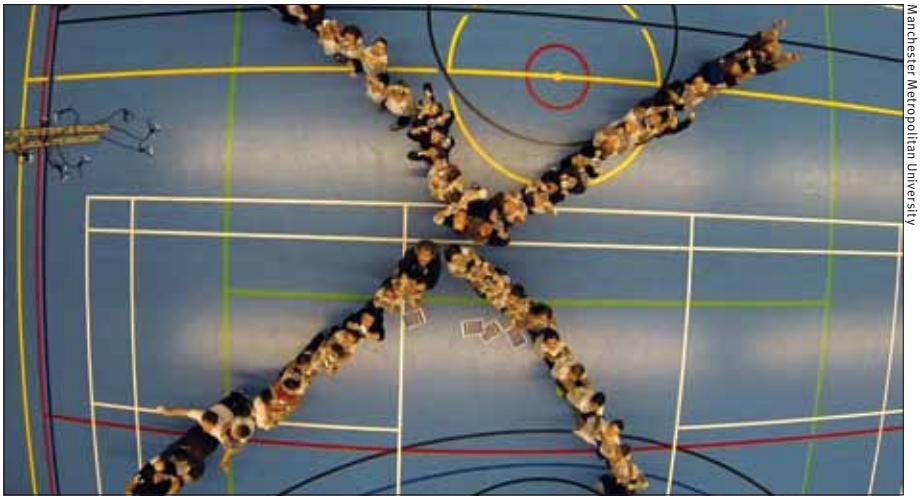
Student events

It's all systems go for Mission X 2015

Schools are embarking on the hugely popular science, education and fitness programme Mission X: Train Like an Astronaut. Using astronaut training to teach how diet and exercise play an important role in human performance in space and on the Earth, Mission X activities are free and can be used by individuals, schools or community groups.

Events to support this programme have been planned throughout the year at UK venues such as Glasgow Science Centre, Royal Observatory Greenwich and the National Space Centre. All schools taking part are also being invited to report on their mission progress at an event hosted by the Parliamentary Space Committee at the House of Commons.

Schools taking part in the programme will be invited to take their astronaut training to a new level with a visit to the man-carrying centrifuge facility at QinetiQ in Farnborough on 4 June. The specialist facility, unique in the UK, is used to prepare fighter pilots and astronauts for the high G forces of air combat and launch/re-entry. During the visit, students will witness the physiological effects of gravity in the laboratory and see how such effects become problematic at the higher levels of "gravity" experienced when the human body is exposed to acceleration.



Manchester Metropolitan University

A drone's eye view of Mission X students.

For more information: visit www.trainlikeanastronaut.org.

Invitation

Get a taste of our summer schools

Invites will be going out soon for the Stimulating Physics Network's flagship event: our residential summer schools. More than 150 teachers will join the IOP's Teaching and Learning Coaches for four days of intensive, immersive physics CPD. Central to each summer school is the chance to:

- attend bespoke workshops on Key Stages 3 and 4 physics;
- listen to inspiring guest lecturers such as Marek Kukula and Maggie Aderin-Pocock;
- collaborate with fellow teaching professionals.

As these courses are free (with travel costs reimbursed), they are open exclusively to teachers at SPN Partner Schools.

For a taste of what the 2015 summer schools have to offer, all teachers are invited to the Highgate Day for Physics Teachers (21 March, London) and the Day for Everyone Teaching Physics (25 June, Durham). Each event features a full day of workshops, lectures and networking, along with opportunities to meet manufacturers and physics publishers.

For more information: visit stimulatingphysics.org/regions or register for a summer school at stimulatingphysics.org/summerschools.

Online CPD

Start talking physics with online workshops

Lemon batteries are used to light an LED, in Dan Cottle's Real Physics with Fruit and Sweets.

Not everyone who would like to attend a physics CPD workshop can. Distance, time, family and school commitments often mean that teachers keen to develop their practice can't make a face-to-face session. The solution is TalkPhysics, our online learning community for teachers of physics.

Real Physics with Fruit and Sweets is the latest workshop from Dan Cottle. It features simple experiments designed to enrich student learning: from diamagnetic grapes, to modelling electron energy levels with Smarties. Dan's workshops usually take place in a room of 10–20 teachers as part of the IOP's Teacher Network. But now, after a crash course in Google Hangouts and support from the TalkPhysics team, Real Physics has debuted live on TalkPhysics.

Dan says: "With the equipment set up on my dining room table, I'll confess to being a little nervous. Not just about the experiments working, but also about being live on video – not something I have done before! There was nothing to worry about though – I just taught as I normally would for about 20 minutes. Everything went well, just as it had done at the face-to-face workshop. Except this time 47 teachers were able to watch live across the country."

The video has since been watched by more than 260 teachers, accompanied by lively discussion in the forums. Keep an eye out for more CPD and physics chat on TalkPhysics – and for next issue's Teaching Tips for a look at one of Dan's experiments.

For more information: visit TalkPhysics.org/groups/5634 to watch Dan's session; or e-mail dan@greencushion.co.uk. To find a Teacher Network workshop near you, visit stimulatingphysics.org/regions.

Teaching Tips: running online CPD
1. Pick a subject matter that is easily viewed via webcam
2. Choose a sensible time and date: one where other teachers are able to attend
3. Practise your experiments beforehand; this will help build confidence
4. Promote widely: use e-mail, TalkPhysics and social media
5. Encourage sharing via the TalkPhysics forums

Signal boost

STIMULATING PHYSICS NETWORK

What Happens Next?

Teachers in Kent can explore a series of experiments with unexpected outcomes, from the Cartesian diver to some slinky physics. You can challenge student preconceptions and discover new lesson starters for the spring term. To book your place for this March workshop, e-mail dahp.twggs@gmail.com.

Find more local workshops at stimulatingphysics.org/regions.

spectraSnapp Happy

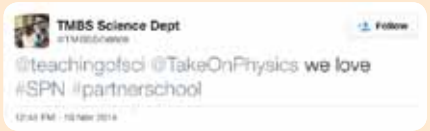
Spring term's digital highlight is an International Year of Light special: spectraSnapp for iOS. Designed by the American Physical Society, this app combines with a simple add-on to turn any mobile device into a hand-held spectroscope. Download a copy at bit.ly/spectraSnapp.

Find more physics apps at pinterest.com/teachphysics.

Activities this spring across the regions

- Pupils from Ashby School, Leicestershire, and St Peter's School, York, won our Girls in Physics challenge competition.
- 276 trainee teachers joined our early-career mentoring programme.
- Central England gained a new Teaching and Learning Coach, Suzanne Woolhouse.
- 47 teachers attended Real Physics with Fruit and Sweets live on TalkPhysics.
- Canons High School became our latest Partner School in London.
- Teachers in the southwest met at Thornden School, Eastleigh, to set up a Link School network.

Twitter
Follow **@TakeOnPhysics** on twitter to connect with the wider physics community.



Resource

Celebrating the start of IYOL

The launch of the International Year of Light (IYOL) occurred in Paris (the "eternal city of light") earlier this year at the headquarters of UNESCO in the shadow of the Eiffel Tower. The two-day programme included talks from Nobel Prize winners, a violin recital and a performance from a London-based Maori club titled "From Darkness to the World of Light". It was a colourful launch that reflected on the history of light going back 1,000 years to the work of Ibn Al-Haytham, as well as the role that light played in the development of humanity.

To mark the launch of IYOL, a special edition of the ever-popular Marvin and Milo postcards has been produced. Each of the eight experiments has a light-based theme.

Also available is a new light collection of teaching resources hosted by the National STEM Centre which – to make it as easy as possible to find the resource you need – is navigable by age group (primary to post-16) and region of the electromagnetic spectrum (from radio waves to gamma rays).

IYOL should inspire physics teachers around the world to explore the impact of light on science and culture with their students. Visit the new teacher resources collection today and create stimulating lesson plans to share the excitement of the year with your students.

IOP

The light display from the launch of IYOL earlier this year.

For more information: and to access the teaching resources, visit www.nationalstemcentre.org.uk/light. To order the light-themed Marvin and Milo postcards (while stocks last), e-mail education@iop.org.

Resource

Travel from cyberspace to outer space on film

This spring term the education charity Into Film is running a film season under the banner "From Cyberspace to Outer Space", focusing on the use of science in movies.

Created to inspire discussion and bring different aspects of science and technology to life, the season will encompass British Science Week, 13–22 March. Through themed topics, dynamic resources and filmmaking activities, as well as CPD sessions for teachers, Into Film will pay homage to science-related films new and old.

Among the new releases included, the season will highlight the Stephen Hawking biopic *The Theory of Everything*, artificial intelligence sci-fi *Ex Machina* and robot-themed animation *Big Hero 6*.

Into Film is a UK-wide education charity that puts film at the heart of young people's learning, contributing to their educational, cultural, creative and personal development. Its film clubs are free to all state-funded schools and colleges and include access to a diverse catalogue of more than 4,000 films, dynamic curriculum-linked and enrichment resources, guidance for filmmaking and film reviewing, one-to-one club support and training and CPD for teachers.

Warner Bros

New technology in A.I. Artificial Intelligence.

For more information: on "From Cyberspace to Outer Space" visit www.intofilm.org/news/articles/launching-from-cyberspace-to-outer-space. Start an Into Film Club today via www.intofilm.org/schools-film-clubs or call 0207 288 4520.

Grants

Royal Society Partnership Grants

The Royal Society Partnership Grant scheme funds STEM (science, technology, engineering and mathematics) projects at primary, secondary or college level in partnership with a practising scientist or engineer. You can apply for grants of up to £3000 to help inspire the next generation with innovative school science projects.

For example, a recent project has seen Cristina Lazzeroni, a particle physicist from the University of Birmingham, working with Bordesley Green Girl School. The students have built and installed a cosmic-ray detector on the school roof, to analyse the effect of the weather on cosmic rays and to investigate if cosmic rays can be associated with particular objects in the night sky. In July, the school will be exhibiting its project at the Royal Society's Summer Science Exhibition in London.

For more information: visit royalsociety.org/education/partnership.

EVENTS FOR TEACHERS

ASE Scotland Annual Conference
Robert Gordon's College, Aberdeen
6–7 March
Several workshops delivered by IOP Teacher Network Co-ordinators within a wider programme to support the teaching of physics, especially the new Higher and Advanced Higher Physics courses. Details and booking: www.ase.org.uk/conferences/scotland2015.

Highgate Regional SPN Day
Highgate School, London
21 March
A free day of physics CPD covering topics such as: using toys at KS3, energy, simple machines, and lots more. Everyone will have an opportunity to attend four workshops (lunch and refreshments are also included). Details and booking: www.stimulatingphysics.org/regions-london-southeast.htm.

Rosetta Mission Twilight CPD
Space Studio Banbury, Oxfordshire
22 April, 4.30–6.30 p.m.
The exciting Rosetta mission and the journey of the Philae lander have captured the public's imagination, but how can the contexts of space exploration be used to tackle curriculum topics? Free CPD for GCSE teachers. Details and booking: nsa@spacecentre.co.uk.

Talk Science
Dynamic Earth, Edinburgh
30 April
Museum of Science & Industry, Manchester
8 June
One-day courses providing techniques for engaging students in discussion about topical science stories. Create "powerful questions" to stimulate discussion, develop your facilitation skills and try activities designed to get students voicing their opinions about science. Free to attend, lunch and refreshments included. Details and booking: www.sciencemuseum.org.uk/talkscienceteachercourse.

41st Stirling Physics Meeting
University of Stirling
21 May
A meeting that will bring you into contact with the latest thinking in physics and physics education, and with colleagues from throughout Scotland. Details and booking: www.stirlingmeeting.org.

27th Rugby Meeting
Rugby School, Warwickshire
4 June
This annual meeting for physics teachers will feature lectures given by leading research physicists and physics education experts, hands-on workshops where you can pick up new ideas and an opportunity to browse the extensive exhibition area. Details and booking: www.iop.org/rugby.

Exoplanets and the Nature of Otherworlds
Berrill Lecture Theatre, Open University
9 June, 7.30 p.m.
The discovery of exoplanets sparked a revolution in astronomy and captured our imagination. Today, about 1000 such objects have been found, but their nature remains mysterious. Details and booking: Prof. Ray Mackintosh (raymond.mackintosh@open.ac.uk).

Science on Stage
Queen Mary University of London
19 June
There will be more than 200 stands from primary and secondary school teachers, plus talks, workshops, shows and more. Places are limited, £10 booking fee applies. Details and booking: www.scienceonstage.org.uk.

A Day for Everyone Teaching Physics
Sjøvoll Centre at Pity Me, Durham
25 June
A free day of workshops and lectures (subsidised by IOP). Organised by the IOP in conjunction with Durham University and the DYHNE Science Learning Centre. Details and booking: Ruth Wiltsher (ruth.wiltsher@iop.org).

Geoscience Education Academy
The Geological Society, London
23–26 July
Now in its fifth year, this Academy provides curriculum-led training and support for science teachers across the UK. This event is free to attend, with all UK travel reimbursed and accommodation in London included. Details and booking: www.geolsoc.org.uk/gea.

EVENTS FOR STUDENTS

British Science Week
Nationwide
13–22 March
British Science Week (formerly National Science & Engineering Week) is a 10-day programme of STEM events across the UK. Anyone can organise an activity, and support is available to help organisers plan. Details of free events and support resources: britishscienceweek.org.

Your Universe Festival
University College London
26–28 March
Secondary school tours will be available on each day of the festival, running from 3–5 p.m. There will be telescopes to look at the Sun, Venus, the Moon and Jupiter (weather permitting). Details and booking: Dr Francisco Diego (fd@star.ucl.ac.uk).

Extreme Physics
Rugby School
28–30 March and 9–11 April
Wycombe Abbey School
28–30 March and 31 March – 2 April
Barnard Castle School
28–30 March
This residential competition for teams of four able Year-10 students, accompanied by their teacher (one team per school) includes: practical challenges, lectures, skydiving in a wind tunnel, indoor rock-climbing, student presentations, and teacher CPD opportunities. Costs are £90 per student and accompanying teacher can attend for free. Booking and details: Peter Bonsall (peterbonsallep@gmail.com) and Helen Pollard (helen.pollard@iop.org).

The Big Bang Fair Near Me
The Big Bang Fair is a free hands-on science day with exhibitions and workshops from local, national and international STEM organisations, as well as a student competition. Find out more about your regional event at www.thebigbangfair.co.uk/nearme. The confirmed venues and dates are:

The Big Bang Fair Yorkshire & Humber
Doncaster Racecourse
23 June

The Big Bang Fair South West
The University of Exeter
25 June

The Big Bang Fair South East
South of England Showground
30 June

The Big Bang Fair London East
Newham College
30 June

The Big Bang Fair London Centre
Westminster Kingsway College
1 July

The Big Bang Fair London North
Stanmore College
3 July

The Big Bang Fair Eastern
IWM Duxford
8 July

Build a model of an exoplanet system

Exoplanets are planets orbiting stars outside of our solar system. One method of detecting them is to obtain a light-curve of the star (see figure 1).

As the planet orbits the star, it obscures part of the star's surface when it comes between the star and the Earth, and the apparent brightness of the star drops. In order for this technique to work properly, the telescope must be very sensitive.

A model of an exoplanetary system can be made using a light bulb (for the star), mounted on a rotating table, and an object representing a planet mounted to rotate around the star. You could use a web-cam and laptop, or a light sensor and data-logger, to obtain the light-curve.

Once you have a working system you could investigate the effects of:

- altering the size of the planet
- varying the brightness of the bulb
- changing the distance of the planet from the star
- changing the speed of rotation of the table.

You could then research real exoplanets and choose one star system on which to base your model. Is your exoplanet's star different from our Sun? Does your exoplanet orbit closer to its star than the Earth? How many planets are there in the system? How far away is the star system from Earth? Once you have all the data you need, decide how you will change your model to model the real star system (e.g. do you want to build your model to scale? Will you include more than one planet?)

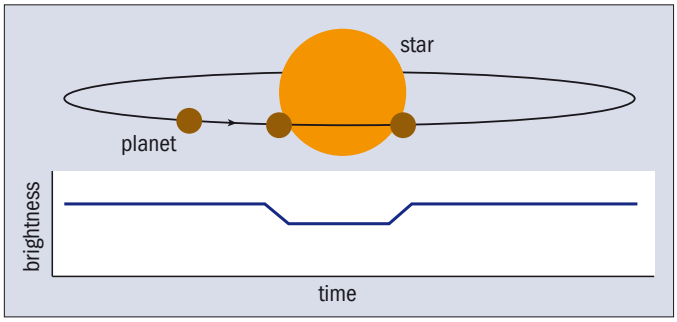


Figure 1. If you measure the light from a star over a period of time, a periodic dip in brightness could indicate the presence of an orbiting exoplanet.

Internet search

Combine "exoplanet" with terms such as: "detection", "light-curve" and "data". Or try:

- planetquest.jpl.nasa.gov
- planethunters.org
- kepler.nasa.gov
- exoplanets.org
- exoplanet.eu

Local links

You may find it useful to link up with a local observatory, or university. They should be able to help with measurements and give you access to better equipment. The actual collecting of data for finding exoplanets like this is cutting-edge research.

Health and safety

Before you carry out an experiment or practical activity:

- find out if any of the substances, equipment or procedures are hazardous
- assess the risks (think about what could go wrong and how serious it might be)
- decide what you need to do to reduce any risks (such as wearing personal protective equipment, knowing how to deal with emergencies and so on)
- make sure your teacher agrees with your plan and risk assessment. Note: Your teacher will check your risk assessment against that of your school. If no risk assessment exists for that activity, your teacher may need to obtain special advice. This may take some time.
- if special tools or machines are needed, arrange to use them in a properly supervised D&T workshop.

EXOPLANET PHYSICS

CREST Awards
A British Science Association programme

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Classroom physics is published by IOP Publishing, Temple Circus, Temple Way, Bristol BS1 6HG, UK.

Ideas for viewing a solar eclipse safely

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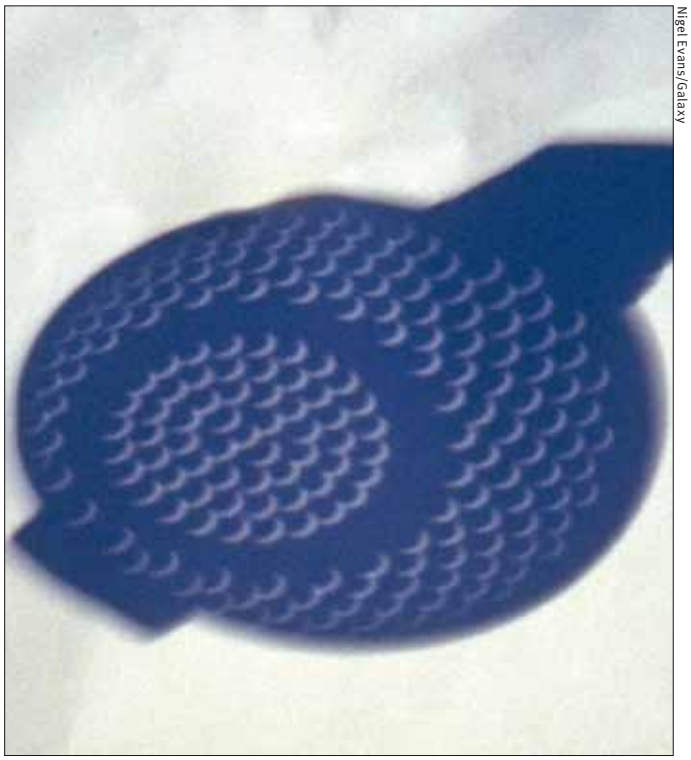
Figure 1. A partial eclipse, photographed using a safety filter in October 2014.



Nigel Evans/Galaxy

Figure 2. Putting eclipses on the menu with a simple colander.

On the morning of Friday 20 March 2015, the whole of the UK will be treated to a partial eclipse of the Sun (see figure 1). If you are planning to view it with your class it is important to remind students that they should never – under any circumstances – look directly at the Sun (even through sunglasses). The only safe way to observe the eclipse is either to use proper solar eclipse viewing glasses or to view it indirectly by, for example, using one of the methods below.

Eclipse viewers

If you are able to find a pair of eclipse viewers or shades then that is a safe and enjoyable way to view the eclipse directly. Eclipse viewers are made of card with special material inlaid, and you hold them up to the eclipse to view it. If you manage to get hold of a viewer, you should check it for damage such as holes or scratches, as only undamaged filters are safe to use.

Eclipse shades are a bit like the 3D card glasses you used to get at the cinema, but they have special dark material in them to cut down the Sun's light by 100,000 times (figure 3).

Never use a material that just looks dark, such as bin liner or gift wrap. Even though it cuts down the visible light, it might not cut out the dangerous infrared light, so you could still do permanent damage to your eyes.

Don't look up at the Sun then hold up the viewer – put the viewer to your eyes before you look at the Sun!

Colanders

By far the simplest way to view an eclipse is to use an item normally found in the kitchen: a colander. Stand with your back to the Sun and hold the colander in one hand and a piece of paper in the other. Hold the colander between the Sun and the paper and watch as you safely observe many images of the eclipse on one piece of paper (as shown in figure 2).

Figure 3. Eclipse shades are made of special material that blocks the harmful rays of the Sun.

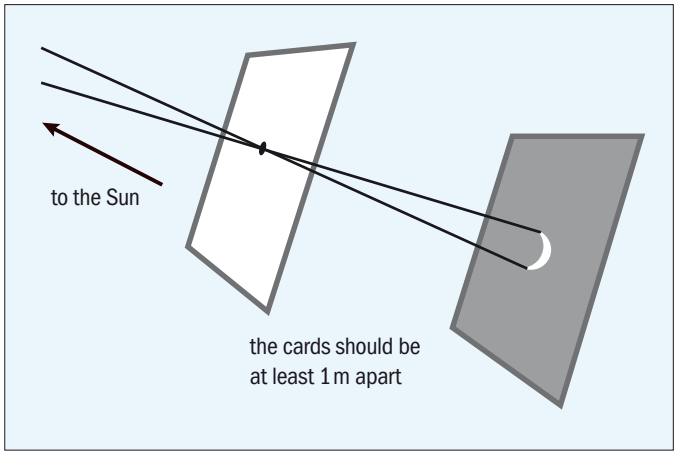


Figure 4. The further apart the cards, the larger the image of the Sun.

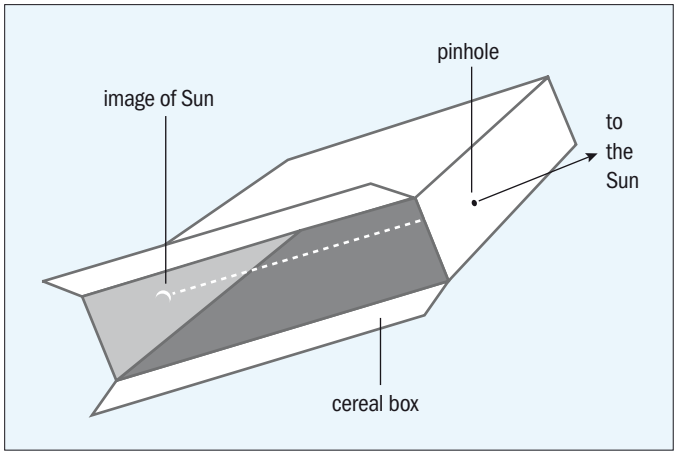


Figure 5. Making a pinhole viewer out of a cereal box.

Pinhole viewers

A simple yet safe way to view the solar eclipse is by making a pinhole viewer. Pinholes allow light through them, and can create an image like a lens. All you need for this are two pieces of white card. Poke a small hole in one piece of card using a compass or a similar tool. Stand with your back to the Sun. Hold both cards up, with the one with the pinhole closer to the Sun. The light through the pinhole can be projected on to the other piece of card, allowing the eclipse to be viewed safely (as shown in figure 4).

An alternative to this is to use a cereal box or similar. Make a pinhole in one edge. Point this towards the Sun and you'll see a tiny image of the Sun projected on to the inside of the packet (as shown in figure 5). Put white paper or card on the inside to make it easier to see.

Never look through the pinhole at the Sun, but only at the projected image.

Mirrors

A small mirror, such as a make-up mirror, can be used to reflect the image of the eclipse onto a light-coloured wall (as shown in figure 6). Do not use a magnifying mirror. Do not look into the mirror at the eclipse as this is just as dangerous as looking directly at the Sun.

Cover the mirror with paper in which you have made a hole no more than 5 mm across. Stand with your back to the eclipse. Use the mirror to reflect an image of the Sun onto a light-coloured wall, being careful not to reflect the sunlight into anyone's eyes.

This works well when you are about 5 m away from the wall. The smaller the mirror and the further away the wall, the sharper the image you should get. Experimenting with the distances and mirror size should make the image brighter. To make the image clearer to see, use an indoor wall in a house and reflect the image in through a window.

Notice that the shape of the hole – even a triangle – still gives a circular disc of the Sun.

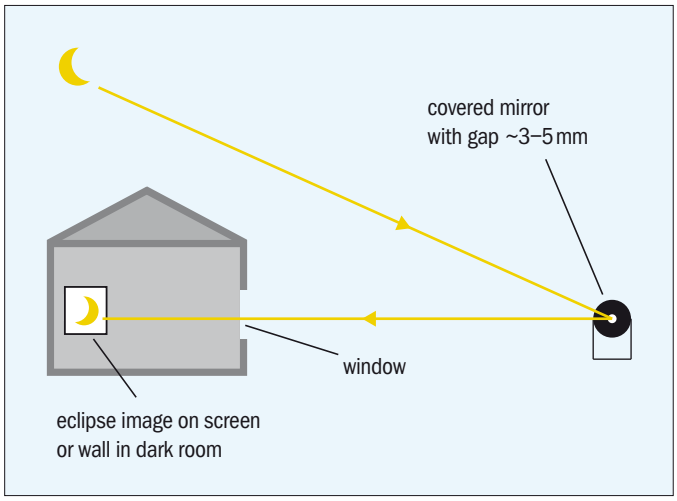


Figure 6. The eclipse image can be projected onto a light-coloured screen or wall in a dark room.

For more information: on how to observe the eclipse safely, visit www.ras.org.uk/education-and-careers/for-everyone/2577-solar-eclipse-2015. To find out the time of the partial eclipse at your location, visit www.timeanddate.com/eclipse/in/uk.

With thanks to the Royal Astronomical Society and Society for Popular Astronomy for permission to adapt part of their booklet "How to observe an eclipse safely".