

# Classroomphysics

The newsletter for affiliated schools

September 2012 Issue 22

## The future of physics is in good hands

The Institute has been working hard to attract new people into teacher training and support them during their early years in the profession. The long-term aim is to help to recruit, employ and work with more high-quality teachers of physics. To this end, we have been leading on many initiatives over the last year.

### NQT Celebration Conference

More than 60 newly qualified teachers (NQTs) of physics braved the Met Office's July weather warnings to come to our 2012 NQT Celebration Conference. They enjoyed workshops ("How to make a straw oboe" and "Why talking is good in physics lessons"), discussion groups ("What can you illustrate with a two-metre-diameter balloon or a variety pack of biscuits?"), and received advice from teachers finishing their NQT induction year.

### School Experience programme

Over the last year our teacher-recruitment campaign has been the strongest to date, with exciting new programmes and improvements put into place to make it even more attractive for new people who are considering entering the profession. Our School Experience programme, where we help prospective teachers to find a school to visit, has this year surpassed our expectations, with more than 190 people supported by the programme and 560 schools involved.



TLC Phil Badley and newly qualified teachers join hands to explore Play-Doh electric circuits.

### Physics with maths

We recognise that the prospect of having to teach chemistry and biology is a barrier for some people thinking about becoming a teacher. This is particularly true for those with an engineering background. We had a pivotal role in the Department for Education's (DfE's) implementation of a new Physics with Maths PGCE course, which has been rolled out nationwide, with the first participants starting this month. This is a huge step for physics initial teacher training and one that we hope you will support and encourage in your own schools.

### Teacher-training scholarships

Our greatest success this year has been the IOP Teacher-Training Scholarships programme, which has awarded 100 scholarships from more than 550 applications to exceptional people wanting to start initial teacher training. Funded by the DfE, we were the only subject association to run a scholarships' programme – a testament to our hard work

and tireless campaigning over the years. Our IOP scholars will be starting their PGCE courses in physics, or physics with maths, across the country this month. We are delighted to reveal that we will be continuing our partnership with the DfE to award more scholarships in 2013.

### Learning to teach physics

Soaring rates of recruitment for new teachers make us optimistic for the future of physics in our schools. But to be confident about its sustainability, these new teachers must have the support that they need in the early years of their careers. Our Learning to Teach Physics programme reaches out to all trainees and new teachers of secondary science, whether they are physics specialists or not. Last year more than 2000 (two-thirds of) trainee science teachers signed up.

**For more information:** on how we support those who are new to teaching physics, visit [www.iop.org/education/ltp](http://www.iop.org/education/ltp).

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

## In this issue

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**4 Resources** New loan scheme from IOM3 includes jet-engine blades, silicon wafers and artificial arteries

**6 Teaching tips** Get your students measuring **8** grains of sand and strands of hair using their own microbalance

Editorial



Welcome back to a new academic year. We hope that you return refreshed and ready for the fray! As ever, there will be changes to deal with in many aspects of school organisation and pupil assessment. However, we hope that you continue to find the Institute of Physics a source of support, with resources, advice and inspiration, to develop your teaching of physics. Pages 1 and 3 have information on the work that we are doing to recruit and retain more teachers of physics and to sustain the work of the Stimulating Physics Network.

We were pleased to award a record number of Teacher Awards this year. The profiles of all eight award winners are in the September copy of *Interactions* and they will receive their awards at the Institute's annual dinner in October.

If you are in an affiliated school this newsletter will be accompanied by two copies of the "STFC Cosmic Ray" posters. They should have been mailed with the June issue of *Classroom Physics* but were inadvertently left out. With two copies you will be able to display both sides of the poster. The teacher support notes are available from the STFC website at [www.stfc.ac.uk](http://www.stfc.ac.uk).

All schools and colleges with a sixth form will receive a pack of materials by the end of September to support their A-level and higher students. This will include a copy of *Pocket Physics* – the replacement for *The Best Pocket Physics Handbook* – containing useful formulae, definitions and data. If you would like individual copies for your students, please e-mail [education@iop.org](mailto:education@iop.org).

Our school grant scheme, which is run in conjunction with the STFC and IET, continues to be popular. We are currently only able to fund about half of the requests, so the quality of an application is important. The deadline for applications is 1 November 2012.

Your comments and suggestions are warmly welcomed so do get in touch.

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# Are lab resources up to scratch?



Royal Society

Students enjoying a demonstration. SCORE supports practical work as integral to science education.

Science Community Representing Education (SCORE), a collaboration of five science organisations including the Institute of Physics, is undertaking research to investigate how primary and secondary schools in England resource practical work and the impact that this has on science teaching and learning. The Resourcing School Science project has two strands.

- The first strand will review existing lists of equipment and consumables, technician staffing, laboratory facilities and access to outside learning, to establish benchmarks in these areas. The benchmarks will be made available to schools at a later date, via the SCORE website, to assist in resource planning.
- The second strand comprises a school survey and will use a variety of measures, including a selection of the benchmarks, to build up a picture of levels of resourcing of school science. The research findings will help to inform national and local policy on the resourcing requirements of science education.

Although the survey will be sent to

a representative sample of schools in September 2012, SCORE is now inviting all primary and secondary schools in England to take part. The survey is being conducted by an external contractor, Pye Tait, and will consist of two 15-minute surveys for primary schools (one for the science co-ordinator and one for the head teacher) or three 15-minute surveys for secondary schools (one for the head of science, one for the head technician and one for a member of the senior management team).

This work contributes to SCORE's long-term policy that practical work is integral to science education. Practical work should be intrinsic to the curriculum and used not only to develop a student's understanding of scientific enquiry and practical skills but also to further a student's scientific knowledge and understanding.

**For more information:** visit [www.score-education.org](http://www.score-education.org). To take part in the survey, e-mail your school's name and contact details to the Resourcing School Science team (e-mail [scoreressourcing@pyetait.com](mailto:scoreressourcing@pyetait.com)).

## IOP | Institute of Physics 16-19 membership

Are your students aged between 16 and 19 and studying physics? They can join the Institute of Physics for free at [www.iop.org/16-19](http://www.iop.org/16-19)



# Government backs Stimulating Physics Network



Institute of Physics

TLCs Jon Clarke and Christine Mayson supporting teachers' development at a Stimulating Physics Network summer school.

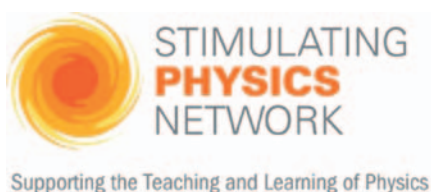
In recognition of the continuing success and impact of the Stimulating Physics Network (SPN), the Department for Education has confirmed its ongoing support for the next phase of the project until March 2014, with annual funding increased from £1.3 m to £1.85 m. This enables us to continue working to increase the number of young people studying physics at A-level and beyond.

The 2010 Schools White Paper, *The Importance of Teaching*, set out a clear commitment by the government to increase the uptake of mathematics and the sciences and, specifically, to look at ways of supporting the in-depth study of physics.

The 2011 education and skills survey by the CBI identified the vital role that science will play in the future of the UK economy. It concluded, "STEM study will continue to unlock an array of opportunities for young people at every skill level". Similarly, a recent report by the Russell Group of universities, *Informed Choices*, confirmed the importance of STEM A-levels as "facilitator subjects" when young people apply to the best UK universities.

## SPN evaluation

Independent evaluation of the recent phase of the SPN (2011–12) showed that



the numbers taking physics A-level in SPN Partner Schools increased, on average, by 20% for girls and 33% for boys. However, in those schools where the SPN had been working longest, the impact was even more marked – an average increase of more than 50% in the number of boys and 150% in the number of girls taking A-level physics. In addition, 37% of Y10 and Y11 pupils, in SPN Partner Schools surveyed, said they might or would definitely take physics at A-level. This compares with 26% of equivalent pupils in a control group of schools.

We currently have the capacity to work with 270 secondary schools across England but additional funding will allow this to increase to more than 430 schools. Each SPN Partner School can also access other

benefits including technician support, residential summer schools, A-level masterclasses, the "Ever Wondered Why" pupil show and online competitions for science clubs. The value of the support given to SPN Partner Schools is estimated to be £5000 per year but there is no cost to either the school or the teachers.

## Stimulating Physics programme supports early-career teachers

As part of the expansion of the Stimulating Physics programme, we are able to offer one-to-one "light-touch" mentoring to some trainee and early-career physics specialists. Each participant is assigned a local Stimulating Physics Support (SPS) mentor. Together, they assess the needs of the teacher as he or she develops their physics teaching, ensuring that this complements support from training providers and school mentors. Each SPS mentor will invite all local early-career science teachers to a termly meeting to help them network and offer support. If you have an NQT in your department they may be eligible.

**For more information:** visit [www.stimulatingphysics.org](http://www.stimulatingphysics.org) or contact Eliza Selley, project co-ordinator, mentoring and research (e-mail [eliza.selley@iop.org](mailto:eliza.selley@iop.org)).

## Students invited to share science knowledge in 'celluloid shorts' contest

Do you know any budding young film-makers who are keen to share their science know-how? The 2012 NPL School Science Film Challenge is now open for entries. The aim of the competition is for students to make an engaging film, less than two and a half minutes long, describing or demonstrating an aspect of science correctly. Prizes will be awarded in various categories and include £500 for the best



film entry from a school. The deadline for entries is Friday 12 October 2012.

**For more information:** visit [www.npl.co.uk/schoolsciencefilm](http://www.npl.co.uk/schoolsciencefilm).



# First Moore medal winner

Are you, or do you know, a great teacher of astronomy or geophysics? Why not nominate yourself or them for the Royal Astronomical Society's (RAS's) Patrick Moore medal? The medal, set up in 2011, recognises teachers who have made an outstanding contribution to astronomy or geophysics education.

The second medal will be presented at the National Astronomy Meeting in St Andrews in July 2013. Nominees do not have to be Fellows of the RAS but should be qualified teachers who normally teach at secondary level. They are expected to have made a significant contribution at a regional or national level.

Last year the RAS gave the first Patrick Moore medal to Dr Becky Parker, of Simon Langton Grammar School, in recognition of her work establishing the Langton Star Centre, with schools across the UK and internationally (for example in Uganda) and developing the Langton Ultimate Cosmic Ray Detector (LUCID) that will fly on the TechDemoSat-1 mission.

**For more information:** visit [www.ras.org.uk/patrickmooremedal](http://www.ras.org.uk/patrickmooremedal) and send your application to Lara Maisey, RAS Events and Awards officer (e-mail [lkm@ras.org.uk](mailto:lkm@ras.org.uk)), by 5.00 p.m. on 28 September 2012.



Dr Becky Parker, winner of the first Patrick Moore medal awarded by the Royal Astronomical Society.

Quentin Stanley, Royal Astronomical Society

# Train like an astronaut on Mission X

Budding young astronauts aged 8–13 years from across the UK are invited to take part in the UK Space Agency's "Mission X: Train Like an Astronaut" – a programme to encourage school students to be more physically active.

The NASA-developed programme uses astronaut training to teach how good diet and exercise play an important role in human performance in space and on Earth. The programme is free and the activities can be used by individuals, schools or community groups.

Students can take part in live link-ups with the International Space Station and find out about life in space. In previous years



Students with astronaut Richard Garriott de Cayeux carry out nutrition, exercise and science activities.

the Mission X programme was supported by astronauts including Tim Peake, Andre Kuipers, Paolo Nespoli, Piers Sellers and Richard Garriott de Cayeux.

The next Mission X challenge will be launching across the UK in January 2013, with 8000 student places available. Teachers can apply on behalf of their class

and will be invited to take part in a training session or webinar with input from NASA.

**For more information:** visit [www.bis.gov.uk/ukspaceagency/discover-and-learn/mission-x-in-the-uk](http://www.bis.gov.uk/ukspaceagency/discover-and-learn/mission-x-in-the-uk) or contact Heather MacRae (e-mail [heather@venturethinking.com](mailto:heather@venturethinking.com) or tel 01279 817 370).

Michael Cokerham

# Science + engineering competition = titles and trips for winners

Do you know of any 11–18 year olds who have carried out their own science or engineering project?

If the answer is yes, you might like to remind them that the National Science + Engineering Competition is now open for online entries. The titles of UK Young Engineer of the Year and UK Young Scientist of the Year will be awarded, as well as cash prizes, international trips and invitations to prominent scientific institutions and research sites.

Finalists will be invited to showcase their projects to judges and visitors at the Big Bang Fair in London, on 14–16 March 2013. More than 100 finalists have already been



Winners from the 2012 National Science + Engineering Competition.

selected via regional heats but there are still plenty of places available in the finals for those who enter online.

Entries can take the form of written submissions or films. The submitted project can be part of an existing scheme – e.g. CREST Awards, Nuffield Science Bursaries or Go4SET, – or it can be an independent

investigation. An entry can be made by teams or individuals but all students should be aged 11–18 years. The deadline for online entries is 31 October 2012.

**For more information:** if you would like to know more and to download a competition guide, visit [www.thebigbangfair.co.uk/nsec](http://www.thebigbangfair.co.uk/nsec).

National Science + Engineering Competition



# Students look ahead with updated websites

myphysicscourse.org

Finding the right degree

IOP Institute of Physics

The Ogden Trust

The websites *Future Morph*, *Tomorrow's Engineers* and *myPhysicscourse.org* have been updated for the start of the new term. The first two help students explore the opportunities that studying science and mathematics can lead on to and the third provides information on degree courses.

*Future Morph* enables visitors to explore the careers available from studying science and maths. It has sections specifically for students, parents, teachers and careers advisors, and shows that studying science beyond the age of 16 is not just a one-track road to a life in a lab. The site includes free teaching resources, interactive games, career profiles, case studies and a resources database. The launch of the new-look website also includes new themes – “Beyond medicine”, “Sport”, “Fashion and



textiles” and “Water”.

The *Tomorrow's Engineers* website focuses on engineering careers and is aimed at 11–16 year olds. As well as illustrating the variety of careers in engineering, the website provides information about apprenticeships and the range of routes into engineering.

The Institute's website for those thinking of studying physics at university is *myPhysicscourse.org*. It has now been updated and carries all of the entry requirements for UK undergraduate physics-degree programmes that start in 2013, as well as details of the university departments.

If you are an affiliated school, enclosed with this issue of *Classroom Physics* are copies of the “Tomorrow's Engineers” poster and leaflet, careers' website listings for science and engineering produced by *Future Morph* and a bookmark for *myPhysicscourse.org*.

**For more information:** visit [www.FutureMorph.org](http://www.FutureMorph.org), [www.TomorrowsEngineers.org.uk](http://www.TomorrowsEngineers.org.uk) and [www.myPhysicscourse.org](http://www.myPhysicscourse.org).

## RSciTech: professional recognition for school science technicians

The vital role that school science technicians play in teaching and learning can now be acknowledged through a new, high-profile framework of formal registration. The professional register created by the Science Council, Registered Science Technician (RSciTech), recognises the professional expertise and subject knowledge of technicians.

Science technicians from across education, research and industry can become an RSciTech if they demonstrate the required competencies and commit to continuing professional development (CPD) to maintain and further enhance their skills and subject knowledge. Technicians with RSciTech can offer a science department up-to-date, cutting-edge expertise, which can help create engaging practicals that inspire students.

To achieve RSciTech status, technicians need to demonstrate that they meet set criteria, involving the application of knowledge, personal responsibility, interpersonal skills, and professional practice and standards. These criteria can be demonstrated through a combination of qualifications and experience. To apply, technicians need to join one of the professional bodies that have been awarded pilot licences for the new RSciTech, three of



Hemalatha Ganeshamurthy receives her certificate from Lord Sainsbury and Vince Cable, secretary of state for business, innovation and skills, at the first RSciTech ceremony.

which are already closely associated with school science education – The Association for Science Education (ASE), The Royal Society of Chemistry (RSC) and The Society of Biology (SoB). Through the application process, technicians will gain access to the support and networks that these professional bodies offer.

Science departments can play a vital role in helping technicians to achieve RSciTech status by encouraging them to

apply, supporting them to recognise the skills that they demonstrate at work and enabling opportunities for continuing professional development. RSciTech status is open to technicians from across education, research and industry, offering invaluable, formal career development that is widely recognised.

**For more information:** to find out more, visit [www.professionalregisters.org](http://www.professionalregisters.org).

# Connecting teachers to the world of materials

The Institute of Materials, Minerals and Mining (IOM3) is launching a new resource to support the teaching of materials: the Materials Discovery Box. These boxes have been designed to give teachers access to examples of unusual materials to help enrich their teaching.

Each box contains a variety of metallic, polymeric, ceramic and composite materials, including a jet-engine turbine blade, silicon wafer, hip replacement, artificial artery, composite aircraft-wing strengthener and a range of smart materials. The samples are accompanied by information cards and a CD of further

details, including curriculum links and presentations. All schools that borrow a box will be asked to share how they use the samples so that a portfolio of activities can be built up over time.

The boxes are available to members of the IOM3 Schools Affiliate Scheme (SAS), which now has a free membership option. They will be particularly useful to schools teaching the OCR B physics A-level but will also be of interest to other science and D&T teachers.

**For more information:** visit [www.iom3.org/sas](http://www.iom3.org/sas) or contact Dr Diane Aston (e-mail [diane.aston@iom3.org](mailto:diane.aston@iom3.org) or tel 01476 513 882).

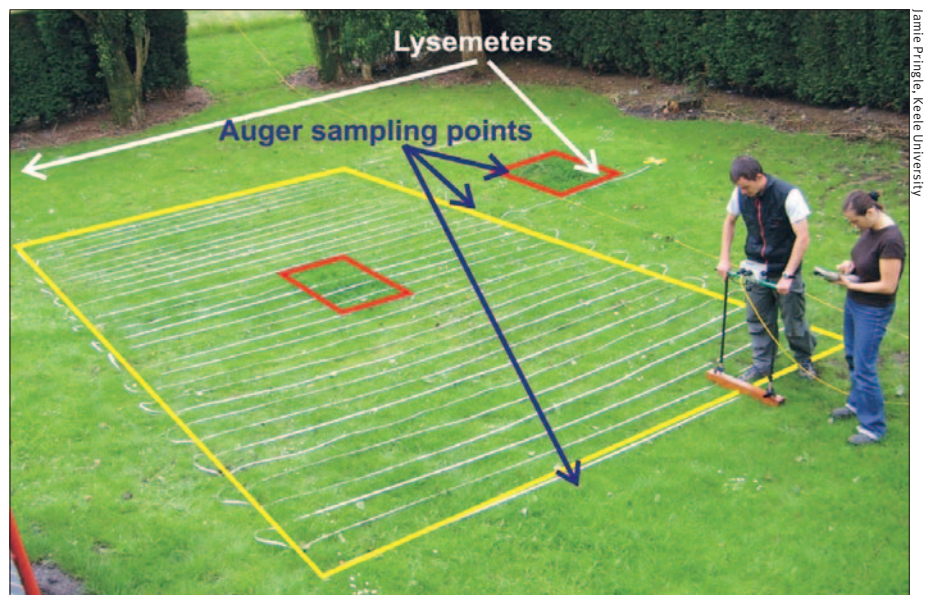


The IOM3 Materials Discovery Boxes contain a range of unusual materials.

## Workshops go beneath the surface for hands-on activities

The Earth Science Education Unit (ESEU) is offering three 90-minute Earth-physics CPD workshops to teachers across the UK. Each workshop shows how physics for 14–19 year olds can be taught through Earth contexts using hands-on practical activities with real-life applications.

- “Tackling climate change through Earth physics” – consider the physics behind how climate change could affect the Earth before investigating different methods of generating power that have low greenhouse-gas emissions, and decide what power source would be most appropriate for your region.
- “The seismology story” – how are seismic waves generated and detected? What can this tell us about the Earth? Try a range of activities to investigate how Earth physics can reveal crucial information about the Earth’s processes and structure.



One of the “geophys story” activities involves making and testing a soil-resistivity device in the lab. Here resistivity is used to detect a “grave” in a field.

- “The geophys story” – use *Time Team* “geophysics” to detect things beneath the ground in the same way as geophysical techniques find archaeological remains,

buried infrastructures and natural resources.

**For more information:** contact the ESEU (e-mail [eseu@keele.ac.uk](mailto:eseu@keele.ac.uk)).

## Online access to practical science with Wolfson lab

The traditional physics practical may have had an occasional electronic facelift but it has not changed much in decades. The appearance is still of wooden benches, wires and springs, for instance – very much a hands-on environment.

Physics in professional laboratories is different. Many physicists have no direct physical connection with their experiments. Actuators drive instruments and data arrive through a computer linked to central facilities such as CERN and satellites. Conversations are with colleagues across the world. It is an online environment.

The Open University has been awarded £1 m by the Wolfson Foundation to reflect this change in practical science in

its teaching. The Wolfson OpenScience Laboratory will provide online access to practical science, not only to Open University students but also to students across the globe. All science subjects will be covered and many of the experiments will be relevant to schools.

The laboratory will include remote access to real laboratories and observatories, for example optical and radio telescopes; virtual instruments such as gamma-scattering apparatus with real data accessed interactively; immersive 3D field investigations with digitised real landscapes; and access to citizen science, including “Treezilla”, a massive tree survey.

The Open University will be collaborating



Students will be able to access remote observatories using their laptop or mobile phone.

with other universities, schools and professional bodies and the priority will be to improve access in developing countries

**For more information:** visit [www.open.ac.uk/blogs/openscience](http://www.open.ac.uk/blogs/openscience).



## EVENTS FOR TEACHERS

### Irish Teachers of Physics Annual Conference: Frontiers of Physics

Science Gallery, Trinity College Dublin  
22 September

This conference aims to inform teachers of the exciting research that is being carried out at the frontiers of physics in Ireland; the latest examples of inexpensive physics demonstrations; and the newest resources available in physics teaching. This year the conference coincides with Dublin City of Science Year.

Details and booking: contact Paul Nugent (e-mail [paulnugent@eircom.net](mailto:paulnugent@eircom.net)).

### 6th Annual East Midlands Network Day

Sir Jonathan North School, Leicester  
29 September

This event is for anyone teaching or supporting physics. The programme will feature the talk "How do we know what the temperature is?" given by Michael de Podesta from the National Physical Laboratory, and the opportunity to attend three workshops from a choice of seven. Details and booking: contact Natasha Plaister (e-mail [natasha.plaister@iop.org](mailto:natasha.plaister@iop.org)).

### SPEED (Stimulating Physics East of England Day)

Netherhall School, Cambridge  
6 October

A day of free physics CPD for science and trainee teachers, delivered by the region's leading physics teaching experts. There will be a talk from a leading physicist (to be announced) and three hands-on workshops covering a range of topics.

Details and booking: visit [www.sciencelearningcentres.org.uk/ee](http://www.sciencelearningcentres.org.uk/ee).

### Cloud Chambers – Make and Take Workshop

St Peters Sixth Form College, Sunderland  
11 October

Cloud chambers allow students to see the paths that ionising radiation has travelled. In this workshop teachers make a take-away cloud chamber big enough for a group of students to see into. There will also be ideas for getting the most out of your dry ice.

Details and booking: contact Ruth Wiltsher (e-mail [ruth.wiltsher@iop.org](mailto:ruth.wiltsher@iop.org)).

### 11th Annual Welsh Physics-Teachers Conference

Christ College, Brecon  
17 October

This free conference is open to all who teach or contribute to the teaching of physics – newly qualified teachers, technicians and student teachers are particularly welcome. The programme features a talk from Prof. Dame Jocelyn Bell Burnell, an exhibition, and workshops covering examination specifications, new apparatus and demonstrations.

Details and booking: visit [www.eventsforce.net/wales12](http://www.eventsforce.net/wales12).

### Geoscience Education Academy

The Geological Society, London  
19–24 October

The academy offers UK teachers the opportunity to develop their teaching in the area of geoscience and includes behind-the-scenes visits to the Natural History Museum and BP. The academy is free to attend with all travel/accommodation included and reimbursed.

Details and booking: contact Joanna Mears (e-mail [joanna.mears@geolsoc.org.uk](mailto:joanna.mears@geolsoc.org.uk)).

### SPN London Regional Teachers' Day

Dulwich College, London  
25 October

A free day of workshops for teachers and technicians from London schools addressing teaching and learning across a range of physics topics. An opportunity to meet physics colleagues and share ideas.

Details: visit [www.sciencelearningcentres.org.uk/centres/london](http://www.sciencelearningcentres.org.uk/centres/london).

### Festival of Physics

Roland Levinsky Building, University of Plymouth

17 November

This event is for anyone with an interest in physics, free of charge and is open to all ages. School parties are welcome. Talks include "The Physics of Superheroes" and "Newborn Stars and Unexplored Planets". There will be a workshop on hydraulics and a "Meet the Scientist" workshop.

Details and booking: contact Miranda Addey (e-mail [miranda.addey@iop.org](mailto:miranda.addey@iop.org)).

### Autumn Physics Update

University of Oxford  
14–16 December

The Institute's ever-popular three-day course will be hosted by the physics department at the University of Oxford. The programme will feature a mixture of talks and practical workshops with the opportunity to share and discuss classroom experiences with fellow physics teachers.

Details: visit [www.iop.org/update](http://www.iop.org/update).

### ASE Annual Conference

University of Reading  
2–5 January 2013

The ASE Annual Conference is open to everyone with an interest in science education, ASE members and non-members. It attracts more than 3000 science educators from all phases of science education and features a selection of talks, workshops, seminars and booked courses. Entry to the exhibition marquee is free.

Details and booking: visit [www.ase.org.uk/conferences/annual-conference](http://www.ase.org.uk/conferences/annual-conference).

### Rugby Meeting

Rugby School, Warwickshire  
6 June 2013

Next year's 25th Annual Meeting for teachers of physics in schools and colleges will offer information, stimulation and communication. The programme will feature lectures given by leading research physicists and physics-education experts, hands-on workshops where you can pick up new ideas and the opportunity to browse the extensive exhibition area.

Details and booking: visit [www.iop.org/rugby](http://www.iop.org/rugby).

## EVENTS FOR STUDENTS

### IOP 2012 Schools and Colleges' Lecture – Physics and the Games: A Winning Formula

This free lecture for 14–16 year olds, given by a team from Sheffield Hallam University's world-leading Centre for Sports Engineering Research, continues its tour of venues across Southern England, Scotland and Wales. Find out how scientists and engineers are using physics to boost the UK's chances of sporting success.

Details and booking: visit [www.iop.org/schoolslecture](http://www.iop.org/schoolslecture).

### Physics in Perspective

London  
17–19 February 2013

This lecture series aimed at sixth-formers and college students offers – over just three days – insights into the many different aspects of modern physics. The next event will take place in London and will include talks on planetary science, nuclear physics, particle accelerators, gravitational waves and oceanography.

Details and booking: visit [www.iop.org/pip](http://www.iop.org/pip).

# Making a microbalance is sensitive work

This is a possible starter activity for a year-12 AS class. Students can work in pairs to produce a balance that is able to measure the mass of a single hair or a grain of sand. The balance is sensitive, if not overly precise, and will give excellent order-of-magnitude values if it is built carefully. The activity is an opportunity to discuss the usefulness of order-of-magnitude calculations.

### Apparatus and materials

Each student group will need the following equipment.

- A wooden block ( $4 \times 4 \times 2$  cm).
- A wooden strip ( $15 \times 2$  cm, for example a medical tongue depressor).
- Two elastic bands (5 cm).
- A fine needle.
- A metal screw (to fit snugly into the end of the drinking straw).
- An aluminium support (see technical notes).
- A drinking straw (waxed paper or plastic).
- Graph paper.
- Scissors.
- Tweezers.
- The students will also need access to a sensitive laboratory balance (for calibration purposes).

### Health & safety and technical notes

- Take care with the needles. Distribute them in a little plastic box.
- The aluminium support is made from a bent sheet of aluminium. An alternative support could be made from two plastic credit-card-sized cards, glued to a wooden block.
- Have plenty of spare straws available.

### Procedure

- Fix the wooden strip to the wood block (as shown in figure 1) using the elastic bands twisted twice around the block.
- Insert the small metal screw in one end of the drinking straw.
- Cut away the other end of the straw with scissors so that it acts both as a pointer and as a little scoop into which items to be weighed can be placed.
- Find the approximate centre of gravity by balancing the straw on the needle. Then push the needle through the straw (just above the long axis of the straw) to act as the rolling axle.
- Use standard masses ( $4 \text{ mm}^2$  paper squares) to calibrate the microbalance. Mark the zero position of the pointer high up on the vertical scale. Put the  $4 \text{ mm}^2$  mass into the scoop and mark the pointer position. Continue adding masses until a uniform scale is constructed.
- Other things to weigh include a flake of mica, a small piece of thread, a small piece of iron wire before and after rusting, a drop of olive oil, and the loss in mass as a drop of ether evaporates.
- Once the mass of a grain of sand is known, estimate and then measure the mass of a beaker of sand.

### Teaching notes

- Once students have a microbalance they will want to know how to calibrate it. Provide a small piece of paper and students will realise that they do not know its mass. The ensuing discussion may lead to using a known mass of paper, which can be subdivided.
- A pile of graph paper can be used as a reference. There should be no margins on the paper. Large squares of  $5 \times 5$  are marked on the paper and each large square is divided into  $10 \times 10$  smaller squares ( $2 \times 2$  mm each). The pile of graph paper should have a

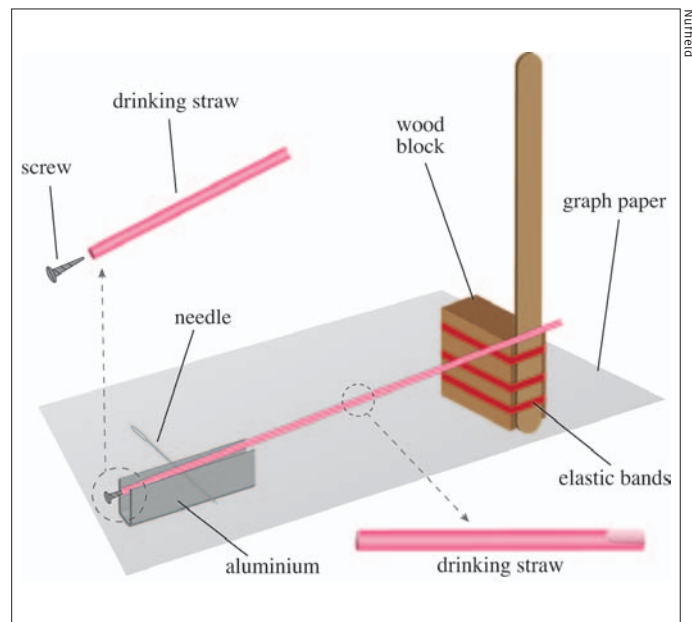


Figure 1. Making a microbalance.

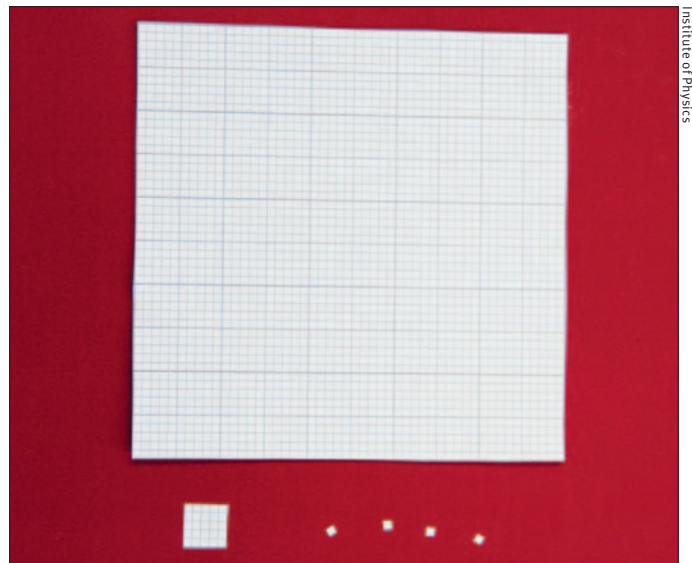


Figure 2. Pieces of paper  $100 \text{ cm}^2$ ,  $1 \text{ cm}^2$  and  $4 \text{ mm}^2$ .

mass of 100 g and this may be conveniently near to 400 sheets. The mass of the pile of paper can be checked on the laboratory balance in advance and labelled accordingly. Note that paper changes in mass depending on the moisture content.

- Once the mass of 400 sheets is known then the mass of one sheet, of one big square and of one small square can be calculated. Grains of sand and short hairs have a mass similar to this. So the vertical scale of the balance can now be calibrated by using one, two, three, etc, small ( $4 \text{ mm}^2$ ) squares.
- The position of the needle (how high up it is on the cross section of the straw) determines the sensitivity of the balance but students can be left to find this out for themselves. However, some students may need help. When help is given, take away the "right" straw that you have set up and give the student a new straw for a fresh attempt.

This activity can be found on [www.practicalphysics.org](http://www.practicalphysics.org).