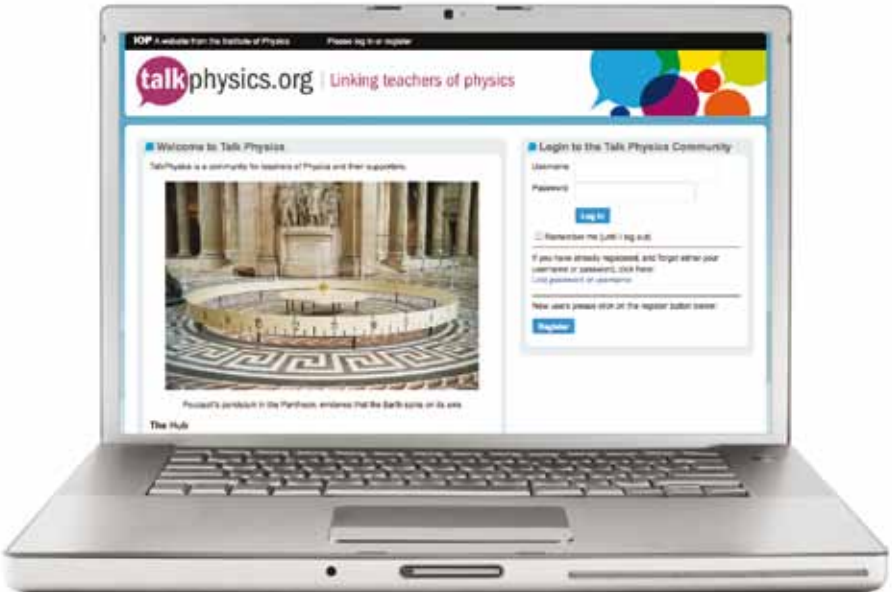
IOP | Institute of Physics
Education *Supporting Teachers*

Classroomphysics
The newsletter for affiliated schools
June 2011 Issue 17

TalkPhysics celebrates first-year anniversary

talkphysics.org is an Institute of Physics website to link teachers of physics. It has had a successful first year with active, high-quality discussion among its 4000 members, prompting such comments as "thanks loads for your help" and "I'll be using this with our physics GCSE groups".

For a decade, the Institute of Physics has run successful e-mail discussion lists for teachers of physics, such as Physics Teaching News and Comment (PTNC) and SPUTNIK (for teachers in Scotland). These are limited to sending plain text, without being able to attach or embed spreadsheets, video files and so on. Over this decade technology has developed rapidly, allowing users of a website to interact with each other rather than only reading the content provided by the site owner. Examples of this Web 2.0 include *Wikipedia* and *Facebook*, which was launched only five years ago and already has more than 500 million users.



Connecting teachers

talkphysics.org is the Institute's attempt to use Web 2.0 technology to enrich online discussions about teaching. Anyone with an interest in the teaching of physics can join, begin or reply to discussions, download the Institute's Supporting Physics Teaching (SPT) resources, create their own groups for discussion of particular topics, and many other things. You can choose to receive e-mail notifications whenever new posts are made. If you choose, the site will "remember" you for a month, saving you logging in each time and making it easy to follow links from the e-mail notifications.

The site was launched on 15 February 2010 and technical work to improve the site continued throughout 2010. By the end of November 2010 it had 3200 members, many of them PGCE students to whom the Institute had promoted the site. It then reached "critical mass" with the vast majority of discussions being started and replied to by members who were not Institute staff. There has been an average of 90 posts per week since then, with a steady stream of new members joining and posting for the first time. Since January, *talkphysics.org* has even been more active than the PTNC e-mail list.

For more information: If you haven't yet joined, register today at www.talkphysics.org and be part of a thriving online community dedicated to the teaching of physics. If you haven't logged on in a while, you could take another look – you may be surprised how much more active and usable the site is. Our thanks to those who have already made contributions – these have made *TalkPhysics* a valuable means of support.
Jon Clarke, Web 2.0 publisher

Editorial

Welcome to the last edition of *Classroom Physics* for this school year. Our front-page story looks at developments that have taken place with our community website *talkphysics.org* over the last year. If you haven't registered yet, now is the time. Teaching tips (p7) gives a flavour of the advice on offer, with an interesting discussion on running an effective revision lesson.

Page 3 covers two interesting events: NPL Water Rocket Day for students and the ESERO Space Conference Day for teachers. Page 5 reports on the Big Bang fair and the physics prize-winner, as well as news of the fundraising campaign, IOP for Africa. This is an opportunity for your students to make links with schools there. An update of the Institute's work encouraging more girls to take physics post-16 is on p5.

Page 4 has news of new resources: Launchbox from the Science Museum, Weatherlabs from Planet Scicast and the Orange/Future Morph app, which allows anyone to have questions answered by scientists. Our classroom activity "Hearing a gas" is an engaging demonstration for the classroom (p8).

The Institute is continuing its work to encourage and support more people to become teachers of physics. If you are able to offer a prospective trainee an opportunity to see what teaching might be like, see the adjacent article (p2).

Affiliated schools will also be receiving a copy of the 2010 Nobel Prize in Physics poster, featuring Andre Geim and Konstantin Novoselov of the University of Manchester, who received the prize for groundbreaking graphene experiments. The Institute has also published a brief information brochure on graphene and its potential. You can download this at www.iop.org/publications or you can order a print copy from education@iop.org. In addition, the mailing includes a DVD of the National HE STEM programme "careers clips" (see March issue, p3).

The Education Forum has been busy, with discussions/suggestions regarding the Institute's response (via SCORE) to the National Curriculum consultation. It is now involved with our curriculum mapping project. To find out more, join the education forum via *talkphysics.org*.

Clare Thomson, editor (tel 020 7470 4981, e-mail clare.thomson@iop.org).

Making the most of the IOP affiliation scheme

Our affiliation scheme for schools and colleges is reaching out to more schools and colleges than ever before. We hope that *Classroom Physics*, *Physics World* and *Physics Education* are useful additions to your physics resources, providing both information and inspiration.

The Institute website (www.iop.org) is the place to visit for information and resources. You can go directly to the education pages at www.iop.org/education. Click on "I am a teacher" to find out about all of the support that we offer teachers and schools, including resources and CPD opportunities. If you would like further resources, posters, careers material or anything else, you can e-mail us at education@iop.org at any time.

When you receive your renewal-subscription request, we also ask you to update the details that we hold for your school and the named person (usually the teacher in charge of physics or head of physics). We want our database to be up to date, so we're grateful to you taking time to complete this form. Currently, we do not have e-mail addresses for a significant number of teachers. We would like to to contact you electronically from time to time, so it is helpful if you can provide this information. In addition, *Interactions* and branch newsletters are now only available in digital format.

For more information: To discuss any of the above, contact our coordinator for affiliated schools, Daniel Josman (e-mail daniel.josman@iop.org, tel 020 7470 4832).

Help potential teachers to gain experience in schools

Are you willing to help the physics teachers of the future make their first steps onto the career path? The Institute often hears that individuals who are thinking of applying for initial teaching training (PGCE) struggle to gain observational experience in a school. The majority of training providers require an applicant to have at least three days of observation under their belt even before submitting their application. At present, there is little support and assistance for individuals to achieve this, resulting in many of them cold-calling schools to no avail.

Our links with teachers and schools across the UK makes it logical for us to develop a school experience programme to support potential teacher of physics trainees. This programme will involve matching a prospective teacher to a school in their region to gain the necessary school observational experience. If your department would be prepared to provide this at any time in the year, please e-mail teach@iop.org with your school's name and postcode, a contact name and the time of year when it would suit you to do this.

Your assistance could increase the numbers embarking on a new career in physics teaching, and, you never know, it might put you in contact with a budding teacher for the future. If you have any questions, please get in touch.

The CREST Awards: 25 years strong and counting

The British Science Association are getting a bit sentimental about the thousands of students who've received a CREST award over the years. In fact, they are trying to find award-winners from every year of CREST's existence to help celebrate its birthday.

If you have a CREST award, join the CREST alumni network and connect with your CREST roots, hear inspirational stories from students attending national and international events – and from alumni who have since gone on to have outstanding careers. You will also hear of other competitions, funding sources and opportunities available through the British Science Association and our other partners. Even better, your stories could help to inspire a new generation of students.

Teachers – if you don't have a CREST award, you may be in contact with past students who have an award and we would like you to pass this information on.

Visit www.britishscienceassociation.org/crestalumni to sign-up to the free network.

Enter the NPL Water Rocket Challenge for an explosive day out

What happens if you mix water and rockets? Come and find out at the National Physical Laboratory (NPL), Teddington, Middlesex TW11 0LW on Wednesday 15 June. The NPL Water Rocket Challenge has been running since 2003 with more than 400 teams having participated in that time. It has raised over £10 000 for charity.

The afternoon event (1.30–5.00 p.m.) is exclusively for school teams, who must be accompanied by an adult, responsible for the team of six students. The infrastructure remains the same for an open-evening event to which older enthusiasts, youth groups and spectators are welcome. Challenges were initially distance and altitude, but presently winners combine landing accuracy (in a zone about 65 m from launch position) with time of flight. To commemorate 50 years of humans in space, we are including an EGGSTRA-special Challenge to transport a payload. Participants in this challenge will win a special certificate.

Participant entry is by pre-registration only at www.npl.co.uk/waterrockets. The £25 entry fee per team (or £5 per person for the workshop) is payable on application and is donated to the Shooting Star Children's Hospice, based in Hampton, Middlesex. Because of high demand, participation is usually limited to one team per school for the afternoon event, but you are also welcome to enter a school team in the open-evening event.

A girls' team with its entry at the 2010 event.

NPL

A boys' team gets ready for blast-off last year.

The NPL has helped other organisations to set up similar events, including the Welsh Water Rocket Challenge and Cheltenham Science Festival.

For more information: visit www.npl.co.uk/waterrockets to enter the competition, find out more about it and get further advice on constructing a rocket. If you have any other enquiries, e-mail waterrockets@npl.co.uk.

Out of this world: secure your place at the ESERO-UK Space Education Day this summer

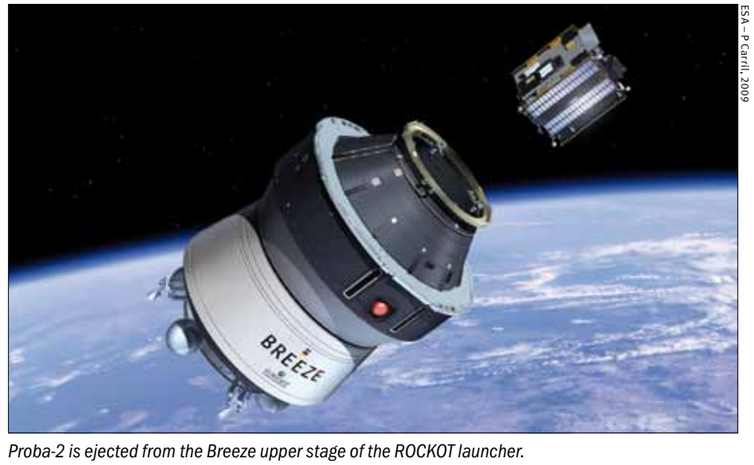
The Space Education Day is part of the UK Space Conference, taking place this year on 4–5 July at the University of Warwick, Coventry. ESERO-UK will be paying for all teachers to attend the day, so don't miss the chance to book your free place.

The day aims to make sense of space exploration and current research, to provide an opportunity to discuss how space can be used in an educational context and to enable teachers to make useful contact with leading space scientists. The day will feature concurrent interactive workshops and lectures aimed at different primary and secondary audiences, with delegates able to choose those of most interest to them.

Inspirational keynote lectures will also offer those attending the opportunity to hear from leading authorities on space research.

Talks will include:

- "Life on Mars" (Prof. David Cullen, Cranfield University)
- "Space as an inspirational context" (Anu Ojha, National Space Centre)
- "Living in the Sun's atmosphere" (Dr Lucie Green, Mullard Space Science Laboratory)
- "Hunt for alien life" (Lewis Dartnell, Mullard Space Science Laboratory)



ESA – P Carril, 2009

Proba-2 is ejected from the Breeze upper stage of the ROCKOT launcher.

Established at the National STEM Centre at the University of York, ESERO-UK (also known as the UK Space Education Office) aims to promote the use of space to enhance and support the teaching and learning of science, technology, engineering and mathematics (STEM) in schools and colleges throughout the UK.

A wealth of freely available resources and expert guidance from a network of space ambassadors is accessible at www.esero.org.uk.

For more information: visit www.esero.org.uk/spaceeducationday where you can download the booking form.

Science Museum unveils action-packed resource

Science Museum

The Science Museum's Launchbox is a brand-new classroom resource for KS3 that gives students the opportunity to explore key areas of physics, such as energy transfer; forces and motion; electricity and magnetism; and light and sound.

Inspired by the museum's popular Launchpad interactive gallery the Launchbox resource builds on the museum's ethos of engaging, hands-on exploration and learning. Each Launchbox contains more than 200 components, plus films, slides and comprehensive teachers' notes, that will allow students to use their understanding of physics to engineer and build a giant chain-reaction contraption.

The Launchbox components can be used in countless combinations so students are free to make their own creations or follow the examples provided to get them started. Everything in the box is reusable, so the resource can be used over and over again. In addition, key components can be reordered, allowing teachers to expand and personalise the contents of their Launchbox.

The resource is already being used in schools in a variety of ways – for example as lesson-starters, for group activities and in STEM clubs. Launchbox grew out of a series of challenge workshops delivered by the Science Museum's Outreach Team across the UK. The workshops set out to interest and engage KS3 students with science through a hands-on approach to scientific investigation. Students worked together to design, build and engineer their own giant chain-reaction contraptions. Feedback from teachers and students about the workshop and the activity was overwhelmingly positive, so the museum decided to develop the unique workshop into a stand-alone resource for teachers to use. Launchboxes are the result.

For more information: about Launchboxes and the Science Museum's full range of teaching and STEM club resources, visit www.sciencemuseum.org.uk/educators/products. Launchboxes cost £200 each and the resource can be ordered by calling 020 7942 4777.

Mobile app helps awareness of STEM careers

Orange's Do Some Good mobile volunteering iPhone app was launched on 31 March. The Science Council has been working with the mobile-phone company on the Future Morph "Hidden Science" mobile-phone action, which will enable the public to have their burning science questions answered directly by scientists.

Future Morph will be highlighting the scientists that answer the questions to show the huge variety of jobs available within science. This action is intended to help to overcome common misconceptions about working with science, challenge gender stereotyping within this area and highlight the importance of STEM skills and their relevance to everyday life.

The app invites questions related to 12 monthly themes, including "Water", "Medical Science", "Food", "Sport", "Travel & Tourism", "Fashion & Textiles", "Earth Science", "Imagining Different Tomorrows", "Disaster", "Wealth & Luxury", "Space" and "Computers & IT". All the answered questions will be posted on *futuremorph.org* and supporting materials for each topic are in development. *Future Morph* is the Science Council's website designed to provide information for young people, their parents and teachers about careers available from studying science and mathematics.

The submitted questions will help to guide the development of teaching resources so that you can contextualise your lessons and effectively raise careers awareness with students. The aim is to show that science and engineering have a huge impact on our lives and really are all around us. You might want to download the app and allow students to submit questions as a classroom activity and then view their answers online, once they have been answered by our scientists.

For more information: on the app or for details about how to download it, visit dosomegood.orange.co.uk. Visit www.futuremorph.org/hiddenscience.cfm to view the questions that have already been answered by the team of scientists.

Resource inspires the forecasters of tomorrow

To support National Science and Engineering Week's focus on communicating science, Planet Science (PS) has created Weather Labs (WL). This is a brand-new and exciting set of resources enabling school students to engage with science by becoming the weather forecasters on their own street.

WL is a unique weather-data feed, accurate to 1 km radius, to stimulate curious minds. For the first time across the UK, forecasts for a 1 km radius around any postcode will be available in two-hourly time slots. By offering a set of specially written advice kits on producing forecasts in various media, PS helps to give young scientists the tools to communicate confidently using exclusive and high-quality data.

WL puts the attention on the scientific processes behind recording and understanding information, predicting events accurately and making statements based on data. In conjunction with the forecasting service Weather Central, PS has brought together partners, including Manchester University and Science Made Simple, to provide additional resources including podcasts and video.

Using the weather data, schools are supported not only in becoming good communicators of data, but also producers of scientific knowledge. PS is running a large collaborative research project as

part of WL, in which schools can check the high-resolution forecasts against actual observations for the precise locations.

For more information: visit weatherlabs.planet-science.com or if you have any questions about Planet Science Weather Labs, e-mail planetscience@tinopolis.com.

Big Bang Fair winner is making waves

A student from Thomas Hardye School in Dorchester is top of the class after winning the prestigious Institute of Physics Prize for Physics in the National Science and Engineering Competition at the Big Bang: UK Young Scientists' and Engineers' Fair. Several hundred young people competed for a range of prizes, including the UK Young Scientist and UK Young Engineer of the Year. Big Bang ambassador, Prof. Brian Cox OBE, and national STEM careers coordinator, Dr Kate Bellingham, presented the awards show, with supporting acts by Sky One's *Brainiac Live!*


The Big Bang

Left to right: Dr. Kate Bellingham, Abigail Davies, Prof. Jocelyn Bell Burnell and Prof. Brian Cox.

Abigail Davies won the physics award with her project on making waves. According to Abigail, it is known that long-distance sea state contributes to increased background seismic noise at low frequencies. Using a school seismometer, this study has suggested that local sea state also affects seismic noise. Background noise was significantly correlated to local wave height along a high-energy coastline. Abigail fought off stiff competition from 155 other entries to be awarded £500 and a trip to the world-leading fusion research laboratory, Culham Centre for Fusion Energy in Oxfordshire.

Charles Tracy, head of education, pre-19 at the Institute of Physics and one of the judges of the Prize for Physics in the National Science and Engineering Competition said: "I'm delighted to award Abigail her prize for a truly inspiring project. The standard of entries was outstanding and the judging process proved much harder than expected."

The Big Bang 2011 brought together 150 different organisations with the shared aim of inspiring the next generation of scientists and engineers, and represented an unparalleled partnership between government, education, industry and the wider science and engineering communities.

For more information: visit www.thebigbangfair.co.uk/nsec.

IOP for Africa goes from strength to strength

IOP for Africa is the Institute's first-ever campaign raising both funds and awareness of its physics-education projects in the sub-Saharan region of Africa. So far it has raised more than £20 000 – enough to fund the initial set-up costs of a new education centre in Malawi. Most recently, IOP member and a research fellow at the University of Nottingham, Dr Andrew Stannard, ran the Virgin London Marathon in aid of the campaign and raised more than £1000.

IOP's education projects in sub-Saharan Africa, which have been in operation since 2005, focus on supporting the development of practical-based physics school curricula, in collaboration with local government institutions. The projects, part of the wider Physics for Development programme, have grown significantly since then.


IOP

Ghanaian pupils investigating solar energy.

Dipali Bhatt-Chauhan, international relations manager at the Institute, says: "The programme has gone from strength to strength, particularly in the last year. It is vital that we keep the momentum going, so to help us in our efforts we decided to launch a new fundraising campaign, IOP for Africa, to help us to spread the word and gain extra financial support."

The Institute's work in Africa began with the development of a school in Kigali, Rwanda, into a physics-education resource centre, thanks to the work of Institute member and teacher of physics David Richardson. Since then, the programme has grown to include projects in Tanzania, Ghana, Uganda, Ethiopia, Malawi and Gambia, at various stages of implementation.

For more information: There are many ways in which you or your school could get involved in the IOP for Africa campaign. Contact corporate communications officer Sara Carbone (e-mail sara.carbone@iop.org) for further details. To find out more about the Physics for Development programme, visit www.iop.org/international.

Update: girls in physics

The Institute has been concerned with the issue of the under-representation of girls in post-16 physics for a number of years. Despite the pleasing increase in the numbers taking A-level physics over the past three years, the proportion who are girls has remained at only 22%. This is a brief update on the continuing work of the Institute in addressing this complex issue.

In 2006, two "red books" were published – *Girls in the Physics Classroom: a Review of the Research on the Participation of Girls in Physics* (Murphy and Whitelegg) and *Girls in the Physics Classroom: a Teachers' Guide for Action*. These publications are still available and have been widely used by teachers to address classroom practice, as well as wider school issues. Following publication of the reports, the Science Learning Centres obtained funding to explore using action research by teachers as a vehicle for change, to improve the engagement of girls with physics. The evaluation team concluded that teachers need time, space and support to make significant changes in their schools, which go on to have a lasting effect.

As part of the Stimulating Physics Project (pilot), the Institute published an action pack for teachers, *Engaging with Girls*, in 2010 and has run a number of workshops to raise awareness of the issues and the resources available. These have been well received and it is clear from this work that there are different levels of awareness and understanding of the issues generally.

The workshops continue to be available at various CPD events, such as the ASE Annual Conference. In addition, many of the schools being supported via the Stimulating Physics Network have expressed an interest in trying to encourage more girls to continue with physics post-16. Their teaching and learning coaches can support them in this area.

For more information: If you are interested in finding out more about this work or you would like to obtain any of these resources, contact Clare Thomson (e-mail clare.thomson@iop.org).

Events

EVENTS FOR TEACHERS

Welsh Teachers Conference
Bangor University
21 June
This free conference is open to everyone who teaches physics. Speakers will include Prof. Dame Athene Donald with a talk on "Physics at the interface with biology" and there will be a variety of engaging workshops.
Details and booking: contact Andrea Fesmer (e-mail andrea.fesmer@talk21.com).

NE Physics Teachers Conference
Durham University
22 June, 9.30 a.m – 2.30 p.m.
This free event will feature lectures, workshops, ICT resources, "Ask a physicist" and more. Lunch is included but places must be pre-booked through the SLC North-East.
Details and booking: contact Nicola Hall (e-mail n.l.hall@durham.ac.uk, tel 0191 370 6200) or visit www.sciencelearningcentres.org.uk/northeast.

Manchester Teachers Conference
Manchester Metropolitan University, Oxford Road, Manchester
22 June, 9.00 a.m – 4.00 p.m.
This one-day event provides a forum to reflect on current challenges in teaching physics and science at KS4. Presentations from local and national institutions and organisations will provide ideas and strategies to help in preparing and presenting materials. There will be free admission for secondary-education delegates and exhibitors.
Details and booking: visit www.sci-eng.mmu.ac.uk/physics2011 or e-mail v.vishnyakov@mmu.ac.uk.

Physics TeachMeet
University of Surrey
22 June, 4.00 p.m.
All teachers of physics or DT at secondary level are welcome to this free CPD discussion event. Food and drink will be provided and travel bursaries are available upon request.
Details: contact c.l.harvey@surrey.ac.uk.

SW Physics Teachers Conference
Exeter University
24 June
This will be an inspiring day of lectures and workshops, and so much more, for all teachers of physics and their technicians.
Details and: contact Alison Alexander (e-mail alisonalexander@aol.com) or visit www.stimulatingphysics.org/regions-southwest.

Annual Liverpool Physics Teachers Conference
University of Liverpool
30 June
For the first time this conference will combine with the 'Physics Can be Easy!' conference as a major free event for all teachers of physics. Dame Prof. Jocelyn Bell Burnell will give a keynote talk and leading national facilitators will provide a wide selection of practical workshops.
Details and booking: contact Lucas Hayhurst (e-mail lht@blueyonder.co.uk).

Earth Science Teachers' Association Annual Course and Conference
Department of Earth Sciences, Durham University
1–3 July
For details on the course and conference programme, contact Dr Paula Martin (e-mail paula.martin@durham.ac.uk). For bookings, finance and general enquiries, contact Linda Marshall, ESTA Conference administrator, (e-mail linmarshall@btinternet.com, tel 01297 551 077).

IOP Yorkshire Branch Teachers Day
University of Leeds, Department of Physics and Astronomy
2 July, 10.00 a.m – 4.30 p.m.
This is a free event and there is no limit on the number of teachers per institution. There will be workshops, seminars and lectures on both classroom and cutting-edge physics.
Details and booking: contact Dr Alex Brabbs, IOP regional officer (e-mail alex.brabbs@iop.org; tel 07795 831434).

Summer Physics Update
H H Wills Physics Laboratory (Department of Physics), University of Bristol
8–10 July
This three-day residential course for physics teachers will feature an exciting programme of lectures and workshops, including Dr Neil Downie's hands-on sessions "Vacuum bazookas and vortex transistors" and an evening wine-tasting session on "The science of taste and flavour" with Prof. Peter Barham.
Details and booking: visit www.iop.org/update or contact Manchi Chung (e-mail manchi.chung@iop.org).

EVENTS FOR STUDENTS

IOP 2011 Schools and Colleges' Lecture: From X-rays to Antimatter: the Science of Seeing Inside Your Body
This free lecture for 14–16-year-olds, given by Dr Michael Wilson, continues its UK tour. For details of dates and venues and booking, visit www.iop.org/schoolslecture or contact Clare Mills (e-mail clare.mills@iop.org).

National Particle Physics Masterclasses Headstart Inspire Courses for Year-11/ Scottish S4 Girls
Newcastle University
13–15 July
BT labs at Adastral Park, Ipswich
25–27 July
These new courses are a valuable preparation for STEM A-levels. As well as taking part in hands-on practical activities, both courses offer the opportunity for the girls to gain some personal development skills, such as presentation, project management, team work and study techniques.
Details and booking: visit www.headstartcourses.org.uk/courses.php or e-mail info@headstartcourses.org.uk for an application form. Places are limited so applications need to be returned asap.

SEPnet GCSE Taster Event: 'What is Physics?'
Range of dates and venues available on request
This is a half-day event for year-9 students at a SEPnet partner campus. The event will cover "Energy and energy resources" as detailed in GCSE specifications. Travel bursaries are available.
Details: e-mail gcse@sepnet.ac.uk.

SEPnet How to Ace Your A-levels
University of Surrey
23 June
University of Kent
8 July
Queen Mary, University of London
3/14 July
This is a full day of activity (10.00 a.m. – 3.00 p.m.) for year-11 students at a university campus, designed to introduce key concepts at A-level. Talks and workshops introduce core concepts, plus lots of tips for passing with flying colours. Travel bursaries are available.
Details: e-mail gcse@sepnet.ac.uk.

Physics Challenge
University of Surrey
4 or 5 July, 10.00 a.m – 3.30 p.m.
This event is for teams of six year-12 students, who will design and build a rollercoaster to compete for prizes.
Details: e-mail c.l.harvey@surrey.ac.uk.

Physics at University Taster
University of Surrey
21 June or 14 July, 10.30 a.m – 3.00 p.m.
The taster will be for sixth-form students interested in studying physics at university. The day will include a talk from one of our lecturers, a practical session in one of our labs and a campus tour. Travel bursaries are available.
Details: e-mailc.l.harvey@surrey.ac.uk.

Q&A: revision lessons

There has been some useful correspondence on *talkphysics.org* recently regarding what makes a good revision lesson. Although this may be too late for this year's public examinations, you might want to try out some of the ideas with other year groups and their end-of-year exams or unit tests.

"Hi, I have an observation after the break with my top-to-middle ability year-11 set. This will be a revision lesson. I would like some ideas please. I have in mind a revision circus but would like to know how to proceed. I am aiming for an 'outstanding' lesson. Any ideas? Which topics could be covered?" Thanks, JH.

Here are some of the responses (edited to make for easier reading, but with lots of different suggestions to try):

PC: Could be good to incorporate some Assessment for Learning activities. Maybe different groups have a few minutes to revise key points from different topics (materials provided by you). Each student could have a number 1–4 and each number revises a different topic. Then they could get into groups of four, with each group containing a "1," a "2", a "3" and a "4". Each student 'teaches' the group the key points/definitions/equations/units etc from their topic.

Next, each group is given four past-paper questions – one from each topic, but each student has to answer the question on a topic that they didn't revise at the beginning. When done, students "roughly" mark each other's work, suggesting improvements, without the mark scheme. Then distribute the mark schemes and get them to mark them properly. Discuss what bits of the questions were they getting wrong? Which bits did they think that they got right as a group, but ended up getting wrong according to the mark scheme?

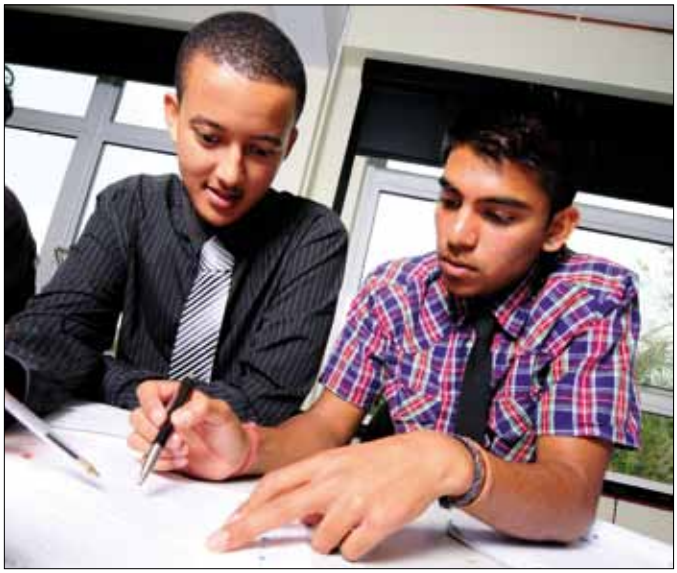
Finish with some sort of plenary – key points from each section etc. What are they clearer on now than at the beginning of the lesson? It's good to get lots of different students to feedback to the rest of the class at this point, so that they can demonstrate to the observer that learning has taken place during the lesson.

JC: Two activities that I've done often with AS-physics students are to get groups to write their own short-exam question, including mark scheme, then get them to pass the question on to the next group. It focuses them on the language used, ensures that they've understood the topic they chose, and gets across unexpected things, like how hard it is to write a good question.

MB: For a revision lesson I would help students to develop skills for the "expensive" questions in the paper. In our syllabus, they are the ones that represent about 10% of the paper's marks in one question, which generally start "Explain…" or "State and explain…".

I would tell the students, in the lesson before, which topic that the revision was going to be on (so that they can revise the topic beforehand) and then gather a few past-paper questions that start "Explain…" or "State and explain…".

In the lesson, pupils work in pairs or by themselves to answer the first question. It is up to you if you let them use their textbook or notes. They then read the answers from **at least** two other pupils and mark them using the mark scheme. You need to keep the timing of the lesson quite tight so that they keep up the pace and you get time to talk through the mark scheme. After the first sample question has been answered and peer-marked, you can draw out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from the students what they perceive as "good" and "bad" answers (appropriate physics vocabulary, structured response, use of bullet points, equations etc). You could also identify a few "good" answers from the class and read them out, highlighting what was "good".

Then repeat the exercise once or twice more with other questions. The second and third time will be faster and the students should be getting higher marks as they apply the rules learned.

If you need a plenary, get them to write a list of three things that they will take away from the lesson to help them to focus their revision – or get them to tell you and you write them on the board so that everyone can share the wisdom.

JH: The tips given above make me feel more confident now. There are a number of options for me now and I am also aware that everyone (students) should be making substantial progress and be engaged most of the time. Furthermore, they should be doing most of the work which leaves me to "troubleshoot". I have a few questions though:
1. Differentiation: how do you provide scaffolding or other support when students are working as a team.
2. Grouping: would four students be the optimum number?
3. Pace: what do you do if one team finishes quickly? Would 15 minutes be ideal for a topic?

MB: Here are a few ideas based on the lesson that I suggested:
Differentiation: able/faster pupils can and should be able to tackle more questions. They should **all** be aiming to move themselves up to get more marks on the questions by the end of the lesson. More-able students could create their own for a peer to do. Less-able students should be focusing on getting the basics right on the questions that you have introduced.
Grouping: the larger the group, the more likely you will get a "free rider" who won't do any work and won't learn anything. I have groups of two, maximum. I set the pairs and for this sort of exercise I would put bright pupils by themselves, the least able with someone good but who has little self confidence and then group the others fairly randomly.
Pace: put times/tasks on the board and stick to them, so that they know what is coming and can pace themselves – then there are no squeals of "we need more time" when you move on.

p.s. JH did get 'outstanding' for his lesson, thanks to all this advice!

For more information: or lesson advice, visit www.talkphysics.org.

‘Hearing a gas’ or ‘Tablets that can change the speed of sound’

This is an intriguing demonstration that should promote discussion among audiences/classes of whatever age. It can be part of a lesson on sound and the properties of waves. At a higher level it might be set in the context of standing waves and fundamental frequencies or the speed of sound in different gases.

Equipment needed:
- Two clear glass bottles of the same size (200/250 ml works well)
- Effervescent antacid (indigestion) tablets
- A drinking straw

You might start by saying something along these lines:

“Most gases are invisible to the human eye and therefore we have to rely on our other senses to detect their presence or make them visible in some indirect way. Smelling is one possibility, but it is not always safe. Hearing might be a good alternative method.”

Then pour equal amounts of water into the clear glass bottles, so that the depth of water in each bottle is not more than about 2 cm, as pictured. Make a tone by blowing over the opening of each bottle and let the class confirm that the notes are the same.

Then take an antacid tablet, break it into two halves and drop them both into one of the bottles. While the liquid is bubbling, ask the class to predict how the notes produced by the two bottles might now be different. Wait until the bubbling ends and then produce tones by blowing over the bottles as before.

Some will say that the bottle with the tablet should produce a note with a slightly higher pitch as the air column in this bottle is now slightly shorter. Although the change in length of the air column will indeed have such an effect (although very small), the main effect comes from the change in the speed of sound.

When the antacid tablet dissolves, it releases carbon dioxide (CO_2). In CO_2, sound travels about 25% slower than in air and the bottle filled with CO_2 produces a note that is noticeably lower than the note produced by the bottle filled with air. Typical values are 220 Hz in air and 206 Hz in CO_2. The change in pitch is smaller than predicted from the change in the speed of sound because there is never pure CO_2 in the bottle.

The speed of sound in air at 0 ˚C and normal atmospheric pressure is 331 m/s compared with 259 m/s in CO_2. This is mainly because of the larger molecular mass of CO_2 compared with air (mostly nitrogen and oxygen). There is an additional but smaller effect from the difference in the ratio of the heat capacity at constant pressure to heat capacity at constant volume, for the two gases.

You can finish the demonstration by putting a drinking straw in the bottle with CO_2 in it, just above the liquid, and blowing several times. The CO_2 is replaced with air (containing a negligible amount of CO_2). If you now blow over the necks of both bottles, the audience should hear that their pitches are again equal (or nearly equal).

A film clip showing this demonstration is available on *YouTube* at www.youtube.com/watch?v=D7K0hbCjzSk&feature=mfu_in_order&list=UL.

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With thanks to **Gorazd Planinšič**, who introduced this idea to me.