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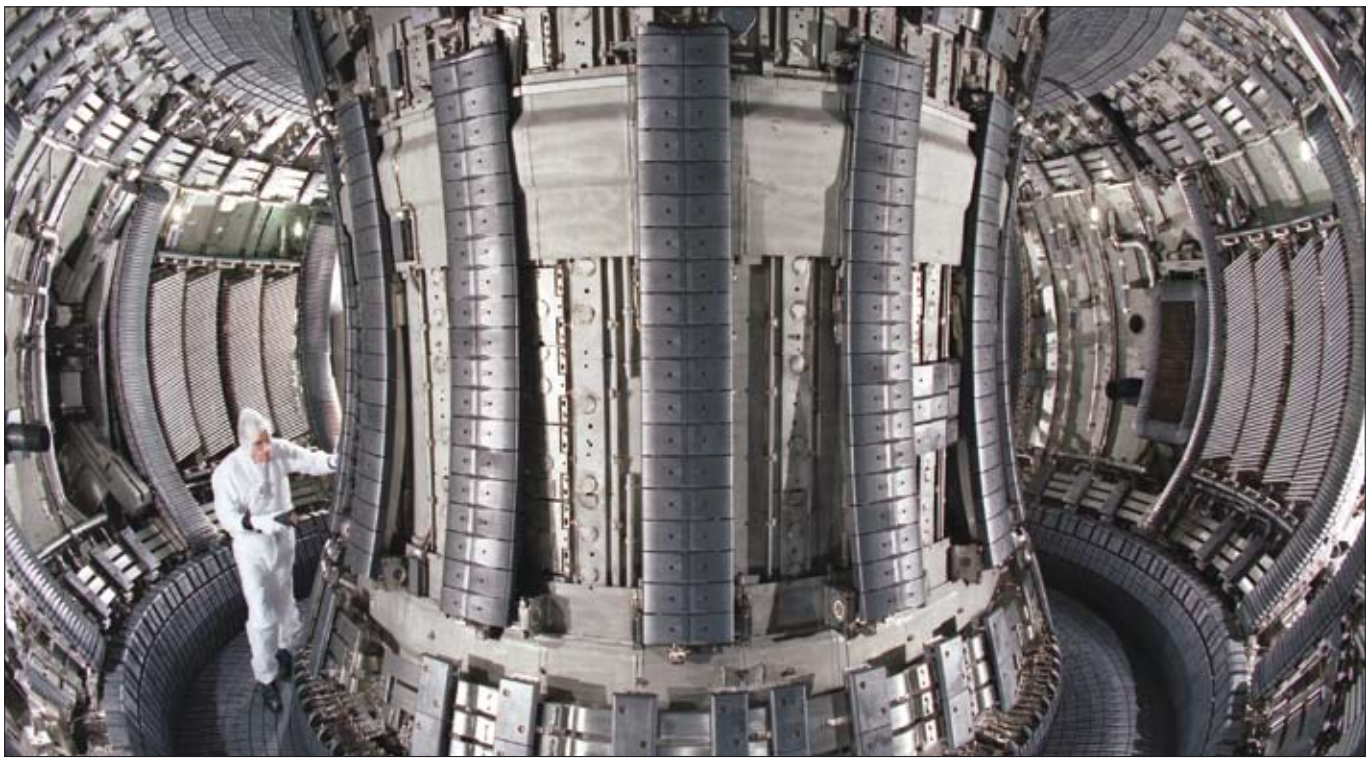
Education *Supporting Teachers*

Classroomphysics

The newsletter for affiliated schools

December 2009 Issue 11



Internal view of the Joint European Torus (JET) vacuum vessel under construction and being co-ordinated by a European Unit at Culham Science Centre.

Physics of fusion powers the future

The 2010 Institute of Physics Schools and Colleges Lecture Tour: How the reaction that powers the Sun could provide a clean energy source for the future

Environmental issues are climbing ever higher on the political and social agenda because of the problems posed by global warming and the rapid depletion of fossil fuels. Physicists are leading the search for a clean, green energy source for the future and it seems that an amazing solution could be found in the reaction that powers the Sun – fusion.

In this lecture Dr Melanie Windridge will explain the physics behind the fusion reaction in which hydrogen particles fuse together to form helium and release huge amounts of energy. Dr Windridge will share the challenges that physicists face in replicating the reaction in massive experiments at places such as the Joint European Torus (JET), the world's largest nuclear fusion experiment at Culham, and she will reveal the exciting potential for harnessing the energy produced in the reaction as an alternative to fossil fuels.

The talk will involve hands-on demonstrations to explain some of the physics behind the fusion process and the technological and engineering obstacles faced by the JET team. The one-hour lecture is free of charge and it is suitable for ages 14 and over. Curriculum links include: How Science Works – applications and implications of science; energy resources; radioactivity; stars; and fusion. The lecture will be touring the UK throughout 2010.

Dr Windridge recently completed a PhD in fusion energy at Imperial College London, spending much of her research time at the JET research facility at Culham. While completing her PhD Melanie gained experience in science communication working on promotional material for Culham Science Centre and regularly attending science festivals. She recently appeared as a guest on BBC1's *Bang Goes the Theory* and Melanie has made many other TV and radio appearances.

Dr Melanie Windridge looks ahead to the future.

For more information: visit www.iop.org/education and navigate to "Events".

Editorial

Welcome to the last issue of *Classroom Physics* for 2009. Your students may be getting in the Christmas mood, while you are hoping to get to the end of that to-do list and make all of the deadlines that are fast approaching. I hope that you are feeling festive enough to share our physics jokes with your students – the tried-and-tested ones are the best (p7).

Our schools lecture for 2010 has a possible power source for the future as its theme and it is featured on the front page. The free lecture will be touring throughout Great Britain during 2010. Make sure that you take the opportunity to go with your class when it is nearby.

If your school is part of the affiliation scheme, you will have received a best-fit line ruler with this issue. More details about this ingenious device and how to order more of them are on p3. News of the latest on CREST awards (p3), the Big Bang fair (p4) and other opportunities for National Science and Engineering Week (p5) show that there is plenty to get engaged with, particularly for gifted and talented students. There is also an update on the Getting Practical CPD programme for teachers (p4).

We also have news of awards for both individuals and schools, with the IOP Teachers Awards (p4) and the Rolls-Royce Science Prize (p5). Both are designed to celebrate and support excellence in the classroom, and the Rolls-Royce prize comes with generous financial support while projects are on-going, as well as the final prize.

Our teaching tip, this time, is a quiz to use with the Institute's "Expand" careers leaflet (p7). Affiliated schools will have a copy in this mailing but it can also be downloaded from our website.

The worksheet on the back page is a radioactivity question loop. This is a useful revision activity and it can be photocopied and used as it is or the answers and questions can be transferred to cards.

We look forward to seeing as many of you as possible at the ASE Annual Conference in Nottingham at the beginning of January. Make sure that you come and say hello to us on stand F13 in marquee 2. As always, any comments or suggestions are welcome.

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

Physics site focuses on careers for students

The careers section on *physics.org* has had a complete makeover. It now features completely new and updated profiles. The site is now much more interactive and it has been designed to encourage students to explore the opportunities available through physics. Students can find out more about a particular job by clicking on it as its scrolls across the top of the page, or they can explore jobs in everything from television to transport by selecting one of the employment sectors featured.

For more information: visit www.physics.org/careers. Contact Taj Bhutta (e-mail taj.bhutta@iop.org) with any feedback.

Resource is out of this world

SimSpace is a game-based learning resource where players take on the role of space scientists, scouting the skies for Near Earth Objects (NEOs) that may pose a risk to life on Earth. The premise is that planet Earth is overdue a major impact from an asteroid or comet, and players are leading the effort to detect any NEOs heading our way. SimSpace can be played in small groups, by individuals or used in a whole-class setting and it is accompanied by comprehensive teacher-support resources, handouts and suggested lesson ideas. This revised version should make it a little easier to manage observing several NEOs at once and so prevent the Earth being obliterated quite so easily as before.

For more information: To download the ZIP files containing the game and all of the associated teacher resources, visit www.iop.org/education and click on "Projects". There are also two SimEnergy games and SimSound to download and enjoy.

Institute's affiliation scheme reviews costs

We have carefully reviewed the cost of subscription to the affiliation scheme for schools and colleges in the UK, which has remained at £40 for several years. Unfortunately, because of increased costs for us, we now find it necessary to increase the subscription for 2010 to £45. We think that this still represents good value and we hope that affiliated schools and colleges will want to continue their membership of the scheme. Subscriptions for the Republic of Ireland and international schools will remain unchanged at €58 and £70 respectively.

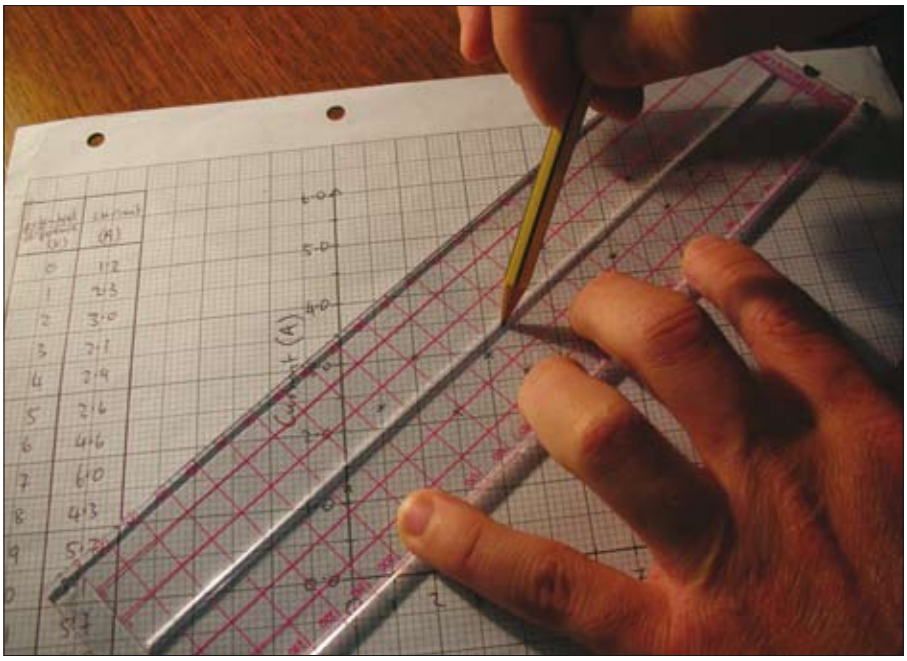
For more information: visit www.iop.org/education and click on "Teacher Support" or e-mail affiliation@iop.org.

Affiliated schools are set to test out new scientific ruler for best-fit lines

The Institute has teamed up with physics teacher Miles Hudson's new company BFLR to produce a batch of Institute Best Fit Line Rulers. Affiliated schools will have received one with this newsletter. The remarkably simple innovation does exactly as its name suggests. For a scatter graph drawn, perhaps using data from an experiment, the ruler will help students to find and draw in the line of best fit for their results.

Essentially, the BFLR is a clear plastic ruler with a slot through it along the middle, and a grid of centimetre squares printed on it. With the ruler lying on a scatter graph, you can see the data points through it. You move it around until the central slot shows the trend pattern of the points, and the grid allows you to ensure that all points are as near to the line of best fit as possible. You can then slide your pencil along the slot to draw in the best-fit line.

The innovative nature of this new design is striking – the sort of thing you look at and think "how come nobody has thought of this before?" Miles hopes that it will make life in science lessons much easier for students, especially for those who have previously struggled to analyse their graphs. As a bonus, the BFLR also functions as a traditional ruler and it can even be used to draw parallel lines or tangents to curves.



Teacher Miles Hudson demonstrates how easy it is to draw the line of best fit with his scientific ruler.

The website has more for teachers and pupils – there are links and downloads to help with learning about graphical analysis and the best-fit line, as well as comprehensive instructions for using the ruler, including photographs.

For more information: visit www.bestfitlineruler.com or you can contact Miles Hudson directly (e-mail miles@bestfitlineruler.com).

Science awards promote the benefits of real-world projects

The British Science Association's CREST Awards have been redeveloped to make them even more flexible. The changes come after a period of consultation with teachers and students.

CREST is Britain's largest national award scheme for project work in the STEM subjects (science, technology, engineering and mathematics). It gives young people aged 11–19 opportunities to explore real-world projects in an exciting way, linking closely to the curriculum while making STEM creative and engaging, in and out of class.

CREST now recognises a wide range of project work – including research, science communication and practical investigations/design-and-make projects. It also encourages cross-STEM subject projects. Research projects created during STEM work experience might also be suitable for CREST accreditation. Some projects might be done in one day or others over several months.

A science student gains some practical work experience during a real-world project for CREST.

The aim is to increase the creativity and real-world relevance of CREST. So, students can investigate or design and make, or they can research a subject, and projects that incorporate video, social media or online surveys are very welcome.

One creative project example relating to physics that could enable students to achieve a CREST Award is the Ashfield Music Festival (visit www.iop.org/education) developed by the Institute and the Career Development Organisation (CRAC). In this activity, featured in the previous issue of *Classroom Physics*, students develop skills in enterprise through taking on roles to design the main stage for a new music festival in Ashfield.

For more information: contact your local co-ordinator if you would like to know more about CREST or if you have got an idea for a new project that may be suitable for CREST accreditation. To find their contact details, visit www.britishscienceassociation.org/crestcontacts.

Institute calls for award nominations

Do you know a great physics teacher or teacher of primary science? Do you have a colleague who is an inspirational and dedicated teacher? If so, why not nominate them for an Institute of Physics Teachers Award? This is a wonderful way to acknowledge and celebrate their work and give teachers the recognition they deserve.

There are separate awards available for teachers of physics and teachers of primary science. Nominations can come from a variety of sources, including head teachers, colleagues, governors, advisers, Institute branch representatives, parents and even students. The winners will be chosen by a panel of current and former teachers and there are no restrictions on the number of awards in each category. The awards are presented at the Institute's annual awards dinner in London.

Award-winners typically have a minimum of 10 years' teaching experience. Good nominations use anecdote and example to bring classroom experiences to life and explain why the teacher makes a difference.

Prof. Bell Burnell presents an award to Charles Buchan at the awards dinner in October 2009.

Evidence from pupils or former pupils is particularly helpful in illustrating a teacher's exceptional qualities.

2009 award-winner Anthony Reeves said: "Winning the award has made an enormous difference to me. I cried (with joy) when I received the notification and the award provided an enormous boost for my self-confidence. To receive public notification for being an outstanding teacher of physics was and is a wonderful feeling."

Charles Buchan, another 2009 award-winner, said: "The award has already impacted in my professional life, both in and out of school. The profile of physics in my school (a large comprehensive) has risen, and the award has been very well received by the community in which I live and work."

The Institute is calling for nominations for the 2010 awards. If you know of an excellent teacher who you think deserves recognition we would be delighted to hear from you. We would particularly welcome more nominations from the primary sector. Any teachers nominated must still be teaching physics/science for most of their working time. Nominations deadline is 31 May 2010.

For more information: Nomination forms can be requested from the education department (e-mail education@iop.org) or found online at www.iop.org/education for electronic or postal submission. These awards are for UK and Ireland citizens only.

Event promises a bigger bang

Riding high on the success of The Big Bang: UK Young Scientists and Engineers Fair 2009, plans are underway for The Big Bang 2010, which will be held at Manchester Central on 11–13 March. Led by the ETB in partnership with more than 50 organisations from across business and industry, government and the STEM community, The Big Bang 2009 was attended by nearly 5000 young people and more than 1500 teachers, politicians, exhibitors, sponsors and members of the science and engineering community.

With 134 science and engineering exhibits, workshops and shows on subjects as diverse as football, forensics, fuel-cell technology, fashion and renewable energy, there was plenty to see and do at the event, with even more to convince young visitors that these subjects provide some of the most creative and rewarding careers around. A further 183 stands showcased highly innovative science and engineering projects from our future stars – namely students from clubs and schools across the UK. Included were projects from the entrants and finalists of the new National Science Competition, which brought together, and built on, the British Science Association's CREST Awards and the Young Engineers Awards.

An even bigger celebration is being planned this time around, providing even more inspiration, to even more students, including those who've never considered a career in the STEM sector before. The Big Bang 2010 will also be open to an even wider age range, with children and students aged 7–19 all welcome, alongside local families, teachers and lecturers. The best entries in the National Science and Engineering Competition will be invited to present their projects at The Big Bang; each with their own stand to show-off all of their hard work to thousands of scientists, engineers, students, parents, employers, teachers and celebrities. A VIP judging panel will be there to find the UK Young Scientist and UK Young Engineer of the Year.

The Big Bang
UK Young Scientists & Engineers Fair

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

Getting Practical update: resource site goes live

Getting Practical

The Getting Practical programme of professional development for teachers at both primary and secondary level is now underway. During the autumn, the trainers have been trained and are ready to work in their local areas with schools wanting to improve the effectiveness of the practical science that they teach.

The programme consists of six hours of training, which will take participants through use of the Getting Practical toolkit. This helps teachers to consider their own use of practical work and its aims and purposes and leads them onto making small changes to improve the effectiveness of their teaching. Local trainers will decide the most appropriate delivery model for their area, possibly using a series of twilight sessions to avoid schools incurring cover costs. The course is offered free of charge.

Getting Practical has recently launched a site at www.gettingpractical.org.uk. Alongside further information about the programme, there is a "Resources" section that features high-quality activities for teachers to use.

Getting Practical is always looking for contributions. To submit any teaching suggestions for practical science, visit the "Your Thoughts" page on the website.

For more information: If you are interested in attending one of the local-area CPD courses, contact Kirstie Hampson (e-mail kirstiehampson@ase.org.uk) or tel 01707 283 000.

Physics high-fliers: the Kells Lane Primary School team celebrate their success with Sir John Rose and the Royal Air Force Aerobatic Team, the Red Arrows.

Inspirational teaching reaps rewards

Kells Lane Primary School, from Gateshead, Tyne and Wear has won the 2009 Rolls-Royce Science Prize (RRSP). The winning project involved the construction of a small-scale wind tunnel for children to safely test and evaluate different blade configurations for wind turbines. Pupils aged 9 and 10 were able to develop wind turbines quickly and test their efficiency by recording electrical output at different wind speeds. Skills from creative thinking to problem solving were demonstrated in finding efficient turbine designs. The school has been awarded £15 000 to further advance science teaching for its students.

The RRSP, now in its sixth year, rewards inspirational science teaching in schools in the UK and Ireland. Kells Lane Primary School was chosen from nine finalists who each received £5000 last year to implement their science projects in the classroom. As part of their award, the team and pupils also spent an amazing day with the Red Arrows.

Rolls-Royce chief executive Sir John Rose presented the school with a trophy and a cheque: "I would like to congratulate all the finalists for their commitment to the teaching of science. Inspiring a new generation of young scientists is vital if we are to compete successfully as a country. I am particularly pleased that Kells Lane Primary School has demonstrated clearly with its winning project that science can help deliver practical solutions to real-world problems."

Kells Lane teacher Simon Smith added: "Taking part in the RRSP has inspired teachers and pupils alike. Winning the award means we can build on our achievements by encouraging children's interest in science and science-based careers. We are already sharing our experiences with other schools in Gateshead."

The runner-up prize was won by Long Road Sixth Form College, Cambridge, which was awarded £10 000 to further science teaching in the college. Students planted a chronological bed with plants of scientific and historical significance and a bed with plants used to make art. This culminated in an exhibition of work and experiments by 350 students.

The RRSP is an annual awards programme with a total of £120 000 in prizes to be won each year. It is open to anyone who attends courses at the network of Science Learning Centres in the UK including those taking advantage of Project ENTHUSE.

For more information: visit http://science.rolls-royce.com.

Science event goes global

The UK's largest celebration of science, engineering and technology has taken on an Earth theme for 2010. This 10-day nationwide science extravaganza sees people of all ages get involved in a huge range of activities; 2009 saw a massive 1.4 million people getting involved in some 3500 events. Funded by the Department for Business, Innovation and Skills and co-ordinated by the British Science Association, National Science and Engineering Week (NSEW) will take place on 12–21 March 2010.

The Earth theme chosen for 2010 could be anything from the following: Earth's amazing phenomena, Earth and its wildlife, Earth's place in the universe, or people and the Earth. A free "What on Earth" activity pack, which contains activities on weather, gravity, plants, movement, energy, soil and fossils, is now available. In addition, the "Einstein's Birthday Party Pack" is available for download. This contains a selection of weird and wonderful physics experiments that can be performed during NSEW.

Along with free resources, NSEW is running a school prize-draw, which has 120 prizes to give out to primary and secondary schools that register their events on the NSEW database before 8 February. If you think that your school's event is extra special then why not nominate yourself for an event award? Your school could win a prize of £500, funded by the Engineering and Technology Board.

For more information: including a range of free resources and details of this year's schools competition, visit the NSEW website at www.nsew.org.uk.

Events

EVENTS FOR TEACHERS

ASE Annual Conference
University of Nottingham
7–9 January 2010
Teachers will be able to meet the Institute's education department staff and enjoy three days of varied workshops and lectures as well as a major exhibition of resources and apparatus. Highlights will include the John Lewis lecture, given by Dame Prof. Jocelyn Bell Burnell, and sessions run by the Institute of Physics Teacher Network.
Details: visit www.ase.org.uk.

The Scottish Science Education Conference "Sustaining Science"
Dunblane Hydro Hotel, Dunblane, Perthshire
5–6 March 2010
Enrich your teaching and learning with "Sustaining Science" – bright ideas for the future. This event will be jointly organised by the ASE and SSERC, with a keynote address given by Prof. Anne Glover.
Details: visit www.asescotland.org.uk/ and www.sserc.org.uk/ or contact Steuart Cuthbert (e-mail steuartcuthbert@ase.org.uk).

Physics Update
University of Southampton
26–28 March 2010
This three-day residential course will feature an exciting programme of lectures and workshops.
Details and booking: contact Manchi Chung (e-mail manch.chung@iop.org or visit www.iop.org/update).

Salters Horners Advanced Physics Residential Courses
University of York
21–23 April 2010: A2 preparation, teachers course
22–23 April 2010: technicians course
If you teach the Edexcel A-level specification and you want to explore teaching through engaging contexts, then these courses are for you.
Details and booking: visit www.york.ac.uk/org/seg/salters/physics/ or contact Sandra Wilmott (e-mail slw5@york.ac.uk).

Welsh Teachers Conference
Bangor University
8 June 2010
This free conference is open to everyone who teaches physics, including non-specialists. Speakers will include Dame Prof. Jocelyn Bell-Burnell, and there will be a variety of engaging workshops, including John Nunn who will be demonstrating the VPLab and Andy Newsam from the Astrophysics Research Institute LJMU.
Details and booking: contact Andrea Fesmer (e-mail andrea.fesmer@talk21.com).

Stirling Physics Meeting
University of Stirling
9 June 2010
A day of lectures and workshops, which will include an exhibition.
Details: contact Claire Garland (e-mail Claire.garland@iop.org).

Rugby Physics meeting
Rugby School, Rugby, Warwickshire
10 June 2010
For all teachers in schools and colleges, this will be a day of information, stimulation and communication. It will include an exhibition and workshops.
Details: contact Manchi Chung (e-mail manchi.chung@iop.org).

Physics Update
University of Sheffield
9–11 July 2010
This three-day residential course will include an exciting programme of lectures and workshops.
Details and booking: contact Manchi Chung (e-mail manch.chung@iop.org or visit www.iop.org/update).

EVENTS FOR STUDENTS

Institute of Physics 2010 Schools and Colleges Lecture: Powering the Future – the Physics of Fusion
This free lecture for 14–16-year-olds, given by Dr Melanie Windridge, commences its UK tour (see front-page feature).
Details and booking: visit www.iop.org/education and click on "Events" or contact Clare Mills (e-mail clare.mills@iop.org).

SEPnet GCSE Physics Outreach Programme
12 January: University of Kent
13 January: University of Southampton
14 January: Royal Holloway, University of London
20 January: Queen Mary University of London
1 February: Aylesbury High School
TBC: University of Sussex
SEPnet, the South East Physics network, will be running a free afternoon energy-revision event for GCSE students at various venues in the South East. The session will consist of a dynamic lecture, an exhibition of hands-on activities and a quiz. In the evening, local teachers will be invited to attend a CPD session, including a chance to try the student activities and a drop-in workshop on teaching energy in the classroom.
Details: visit www.sepnet.ac.uk and click on "Outreach/GCSE events" or contact Clare Harvey (e-mail clare.harvey@sepnet.ac.uk).

Tyndall Lecture for Schools 2010: Physics in Action
January 2010
This free lecture, given by Dr Cathal Flynn from the School of Physics, Dublin Institute of Technology, will be touring Ireland in January.
Contact details, dates and venues: visit www.iopireland.org/activity/education/.

Physics in Perspective
University College London and the Royal Institution
14–16 February 2010
This will be a three-day course for sixth-formers and college students, with the purpose of bringing to participants some of the excitement, relevance and fun of physics. It will consist a series of six lectures or lecture–demonstrations. Free time is scheduled in to allow participants an opportunity to explore other aspects of London. Discounted accommodation is available through Minerva Travel.
Details: contact Manchi Chung (e-mail manchi.chung@iop.org).

National Particle Physics Masterclasses 2010
March–May 2010
This popular series of one-day events for sixth-form students and their teachers, run by practising particle-physics researchers at various institutes all over the country, will be held throughout March and May.
Details: visit www.particlephysics.ac.uk/teach.html.

Advancing Physics Revision Roadshow
All venues will feature sessions for both AS and A2 students.
24 March 2010: University of Bristol
19 April 2010: University of Durham
20 April 2010: University of Birmingham
22 and 23 April 2010: University College London
The roadshow will cost £20 per student, which includes revision sessions, handouts, lunch and refreshments. Accompanying teachers can attend free of charge. Book early to avoid disappointment.
Details and booking: visit http://advancingphysics.iop.org.

Festive fun: jokes for young physicists

Here are some tried-and-tested physics jokes that you may want to share with your classes as we get near to the festive season.

Q: What is the name of the first electricity detective?
A: Sherlock Ohms.

Q: What's a nuclear physicist's favourite meal?
A: Fission chips.

Q: Where does bad light end up?
A: In a prism.

Q: What did the thermometer say to the graduated cylinder?
A: You may have graduated but I've got many degrees.

Q: Why did the electron cross the road?
A: The other side had more potential.

Q: How many quantum physicists does it take to change a light bulb?
A: Depends how you look at it.

Q: What did one uranium-238 nucleus say to the other?
A: "Gotta split!"

Q: Did you hear about the restaurant NASA is starting on the Moon?
A: Great food, no atmosphere!

If it isn't Dark, it doesn't Matter.

Heisenberg is out for a drive when he's stopped by a policeman. The policeman says: "Do you know how fast you were going?" Heisenberg replies: "No, but I know where I am!"

A bar walked into a man. Sorry, wrong frame of reference!

Two atoms met for lunch. One atom suddenly said: "Oh no, I've lost an electron!"
"Are you sure?" the other atom replied.
"Yes," said the first atom. "I'm positive!"

A neutron walks into a bar. He asks the bartender: "How much for a beer?"
The bartender looks at him and says: "For you, no charge."

For red T-shirts only: "If this T-shirt looks blue, you're running too fast."

~~$E = ma^2$~~
~~$E = mb^2$~~
$E = mc^2$

Quiz 'expands' students' outlook on A-level physics

"Expand" is the Institute's careers leaflet for 13–16-year-olds. Designed to encourage more students to consider studying physics at A-level, it profiles people from a diverse range of backgrounds who are now working in a number of different areas, from astrophysics to TV production.

If you want to use it in your lessons, then you may find our new quiz useful to help with engagement. It requires the students to read through the leaflet and identify the transferable skills and knowledge that studying physics develops.

For more information: If you are an affiliated school, a copy of the quiz is enclosed with this edition of *Classroom Physics*. Alternatively, it is available to download at www.iop.org/education (click on "Careers" and "Publications").

Question loop for radioactivity

Teachers' notes: photocopy onto A3 paper and cut out each answer-and-question pair. Give one to each group of pupils, making sure that you use all of them. Anyone can start, reading out their question and the group with the correct answer should respond. They then read out their question and so on, until all of the questions have been read and answered and the loop returns to the start. This can be repeated in a number of different ways to assist with memorising the properties of atoms and ionising radiations.

A ... through eating, drinking or breathing in the materials.
Q Radioactive atoms emit radiation from their ...

A ... nuclei.
Q The nucleus of an atom contains ...

A ... protons and neutrons.
Q Protons and neutrons have the same ...

A ... mass.
Q Protons and electrons have equal amounts, but opposite kinds of ...

A ... charge.
Q Isotopes have the same number of protons in their nuclei, but ...

A ... a different number of neutrons.
Q Radioactive isotopes are unstable, which means that ...

A ... (for their mass) the ratio of protons and neutrons in their nuclei is not correct.
Q The three types of radiation emitted by radioactive materials are ...

A ... alpha, beta and gamma radiation.
Q Alpha particles are the same as helium nuclei and consist of ...

A ... two protons and two neutrons.
Q Alpha particles don't travel very far in air ...

A ... because they are strongly ionising.
Q A sheet of paper or skin stops ...

A ... alpha, but not beta or gamma radiation.
Q Beta particles are ...

A ... fast-moving electrons (emitted from the nucleus).
Q Beta particles are stopped by ...

A ... a few millimetres of aluminium (or lead etc).
Q Gamma radiation is part of the ...

A ... electromagnetic spectrum.
Q Gamma radiation is strongly penetrating and only partly stopped by ...

A ... several centimetres of lead.
Q How might we get radioactive material inside our bodies? ...