

# Classroomphysics

The newsletter for affiliated schools

March 2017 Issue 40

## Curriculum

# Energy changes in the new GCSEs

**The new GCSE specifications contain a revised set of statements about energy. These changes have, understandably, caused concern for teachers about what it means for them and their practice – and the assessment of their students. IOP Head of Education Charles Tracy gives some background, some reassurance and some offers of help.**

The new GCSE criteria<sup>1</sup> do not require detailed knowledge of the language used in any particular teaching approach. Specifically, teachers will not be required to train students to use the familiar but flawed<sup>2</sup> labelling scheme based on transformations between (nine) forms of energy. The problems with the “forms and transformations” metaphor have been the subject of research articles and curriculum discussions for more than 30 years<sup>3</sup>. Therefore, although the approach is deeply engrained, the new criteria provide an opportunity to let it go.

Teachers are now free to develop in their students a more sophisticated understanding of energy – as a concept and as a tool. Over the years, a number of approaches have been proposed to help do this. However, those approaches have never taken hold because of the requirements of exam specifications.

Now that these specifications have changed, there is an excellent opportunity to think again about the language, the metaphors and the purpose of teaching about energy, and for developing an approach that takes into account the research and thinking of the last few decades<sup>4</sup>.



*IOP energy workshops like this one can help you think again about the way you teach energy.*

One such approach is described in the IOP’s Supporting Physics Teaching (SPT) materials<sup>5</sup>. This resource is informed by evidence and provides a language and an analytical framework that is consistent, clear and powerful. It is based on a representation using stores and pathways which, amongst other important aspects, separates the ways in which energy can be stored (for example, gravitationally, elastically, through movement) from the processes that result in energy changes (heating and working). And, as a metaphor, its constituents align more closely to how physics describes the world.

However, it is important to note that, whilst we strongly recommend the approach described in SPT, and we know from our training sessions that it works well in lessons (especially at Key Stage 3), it is neither

compulsory nor strictly necessary for GCSE exams. The exams should test students’ understanding of energy and their ability to use it as an analytical tool rather than test the details of any single teaching approach. In the same way that the familiar language of forms and transformations is not embedded in the GCSE criteria, neither is the language about stores and pathways.

However, it is not yet clear what the exam questions will look like. And this is, understandably, a source of anxiety for teachers. We are working closely with the exam boards to establish how best to examine ideas about energy and we expect that they will produce more examples and materials before the first examinations.

In the meantime, this is a genuine opportunity to think again about the way you teach energy. Our teams of Physics Network Co-ordinators and Teaching & Learning Coaches run energy workshops throughout the year across the UK – check our events calendar to find an event<sup>6</sup> near you to kick-start your rethink.

### More information

- 1 Where are the changes coming from? [bit.ly/gcsesci](http://bit.ly/gcsesci).
- 2 What’s the problem with “forms and transformations”? [bit.ly/TPenergy](http://bit.ly/TPenergy).
- 3 References to articles about the teaching of energy [bit.ly/TPenergy](http://bit.ly/TPenergy).
- 4 Charles’ teaching energy blog series: [bit.ly/TPenergy](http://bit.ly/TPenergy).
- 5 Energy topics in supporting physics teaching [supportingphysicsteaching.net/EnHome.html](http://supportingphysicsteaching.net/EnHome.html).
- 6 Search for energy workshops at [talkphysics.org/events](http://talkphysics.org/events).

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

## In this issue



**National Careers Week 3, 11**  
Get your students thinking in new ways about careers in physics.



**Electromagnetic blues 5**  
Fitting physics content to the tunes of familiar songs are a great way to learn.



**NEW digests 8, 9**  
The best of *TalkPhysics*, *IOPblog*, *Physics Education* and *Physics World*.

## Editorial



We're very pleased to welcome you to this special edition of *Classroom Physics* – we are delighted to be celebrating 10 years (that's 40 issues).

Our front page addresses the changes to the energy language used in the GCSE specifications this year. The new approach has caused some discussion and will have caused all teachers of physics to look anew at how they teach this topic. Charles Tracy's article gives some background to the changes, demonstrates why they are positive and explains how the IOP is supporting teachers through them. The links at the end are really worth exploring.

You'll have received this issue just in time for two important events: National Careers Week followed immediately by British Science Week. For the former, we have created a careers crossword that you can photocopy, and UK affiliated schools will receive our *Expand* leaflet, aimed at students considering their options at 16, plus a flyer from the UK Electronics Skills Foundation about careers in electronics. Our teaching tip is a demo for Science Week.

To celebrate our anniversary we have produced a compilation of *Classroom Physics*' best teaching tips, which we hope you enjoy. There have been some great ideas, such as 2014's classic "Seeing pink elephants" and 2007's "The world's largest coin".

We are also experimenting with more pages. We have found that we needed more space for news and have added digests of articles from other IOP publications and a Marvin and Milo cartoon (quick and easy demos by our cat and dog experimenters).

Do contact us with any feedback on the contents of this issue or on anything you would like to see included in future issues of *Classroom Physics*.

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Photography by **Daniel Josman**

## Reflection

# Classroom Physics reaches 10 years and 40 issues



A decade of Classroom Physics: 40 packed newsletters, from the first edition in 2007 (top left).

When I started working in the IOP Education Department 10 years ago, one of my first projects was to revive the newsletter for affiliated schools. The aim was to keep teachers up to date with all that the department was offering in terms of resources and support, as well as the new projects and initiatives that they were embarking upon. We wanted to continue to provide information on activities, resources and support offered by other organisations.

We came up with a design that is very close to that of today, and were unsure as to whether we could fill the five or six pages of news on a regular basis, but that has proved not to be a problem! I was concerned that the teaching tip and worksheet at the back of the newsletter would just be page fillers, but they have evolved into useful ways of introducing our new resources to busy teachers. We do hope that you value them and enjoy the anniversary compilation included with this issue.

The newsletter remains important because, while schools have undergone almost continuous change over these past 10 years, both in terms of examinations and what the government expects of them, the

actual craft of teaching engaging lessons in the classroom remains at the heart of what teachers do, and want to do better.

The digital revolution means that there is a huge amount of information available, but by pointing out the most relevant and worthwhile resources, we aim to prevent teachers wasting time on fruitless searches. So while most of the newsletters that the IOP sends out are now electronic, *Classroom Physics* has remained paper-based, keeping it separate from the daily email deluge that teachers face.

The aims of *Classroom Physics* remain unchanged – to ensure that all teachers of physics know about our support and resources and feel that they are part of a community that values them and their skills.



**Clare Thomson**  
*Classroom Physics* editor  
2007–2014

**For more information:** read previous copies of *Classroom Physics* at [talkphysics.org/groups/classroom-physics](http://talkphysics.org/groups/classroom-physics). Visit the IOP Education Department at [iop.org/teachers](http://iop.org/teachers).



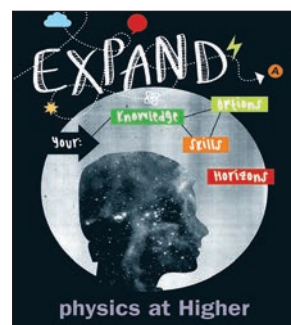
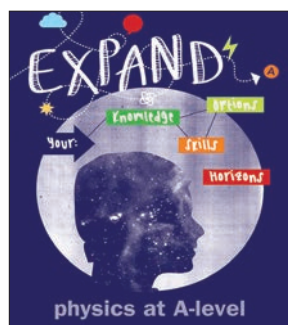
Careers

# National Careers Week 2017 ready for launch

Although some of your students may be planning to become physicists, others may be wondering where else studying physics might take them. UK National Careers Week (NCW), which starts on 6 March, is a great opportunity to illustrate the wide range of careers that physics can lead to.

We have created a crossword worksheet for your students on page 11. The answers (see bottom of page 10) are all careers that benefit from a post-16 qualification in physics. For Scottish and English schools, we've also included copies of the latest *Expand* careers leaflet for 14–16 year olds so that your students can look further into these careers.

Visit the IOP blog for our new profiles of people who studied physics, some of whom are now pursuing careers students may not



previously have considered. During NCW, we'll be updating our social media channels with more examples.

National Apprenticeship Week coincides with NCW and we will be launching some new pages that will outline opportunities in physics-based apprenticeships on our website.

**For more information:** on National Careers Week visit [nationalcareersweek.com](http://nationalcareersweek.com). Read the IOP blog at [iopblog.org](http://iopblog.org), follow us on Twitter @[physicsnews](https://twitter.com/physicsnews) or visit [iop.org/careers](http://iop.org/careers). Careers videos are available at [bit.ly/IOPfuturecareer](http://bit.ly/IOPfuturecareer). To order more copies of the *Expand* leaflet for your students, email [education@iop.org](mailto:education@iop.org).

Careers

## Fundamental physics in Ireland and Scotland

When students ask why they should study physics, demonstrating just how important it is to the national economy can be helpful.

The IOP recently published reports on the role of physics in supporting economic growth and national productivity in Ireland and Scotland. The reports show that physics

is thriving in both nations – and contributes significantly to the national economies.

Similar IOP reports are due to be launched soon for Wales and the UK as a whole.

**To view the reports:** visit [bit.ly/IOPeconomies](http://bit.ly/IOPeconomies).

Ireland (data for 2014)
<ul style="list-style-type: none"> <li>Physics-based industries generated €48.7 billion.</li> <li>160,000 people or 8.6% of the workforce were employed by physics-based industries.</li> </ul>

Scotland
<ul style="list-style-type: none"> <li>Physics-based industries generated £43.5 billion in 2013.</li> <li>199,000 people or 7.9% of the workforce were employed by physics-based industries.</li> </ul>

Prizes

## Winner of the IOP Ireland Award

Cormac Larkin, of Coláiste An Spioraid Naomh in Cork, received the Institute of Physics Ireland prize at the 2017 BT Young Scientist and Technology Exhibition (BTYSTE). His project, “Data Mining in Observational Astronomy: The Search for New OB Stars in the Small Magellanic Cloud”, stemmed from a week-long programme at University College Cork during his transition year, which in turn led him to work at Armagh Observatory and with astronomers at Trinity College Dublin.

**For more information:** [btyoungscientist.com](http://btyoungscientist.com).

Careers

## Free electronics training and kit for teachers

The electronics industry in the UK is growing, yet demand for suitably skilled graduates currently outstrips supply, according to the UK Electronics Skills Foundation (UKESF).

They are inviting physics teachers on a free residential electronics course at the University of Southampton in the summer. The course will include time working in the laboratories with hands-on activities, provide materials to use in teaching and offer an insight into the university's admissions process.

This summer workshop is part of a wider collaboration between the University of



The University of Southampton's audio mixer board.

Southampton and UKESF. They are developing a hands-on tool for A-level physics.

Teachers will be able to use these classroom sets with a series of activities based on the electronics units of the A-level physics curriculum. The circuit board centres around a “music mixer” circuit, combining two audio signals that students can control by experimenting with different resistors and light-dependent resistors. All of the components are visible to help students understand the role of each component.

**For more information on electronics careers:** see the UKESF infographic included with this issue of *Classroom Physics*. Register for the University of Southampton CPD at [www.workshop.soton.ac.uk](http://www.workshop.soton.ac.uk). Visit UKESF at [ukesf.org](http://ukesf.org).

**Professional accreditation**

# Become the first IOP registered school science technician

The IOP now holds the Science Council professional register for Registered Science Technician (RSciTech) – could you, or someone in your school, become the first school physics technician to achieve this award?

The RSciTech designation is aimed at those in technical roles delivering scientific services, such as technicians. We also hold the licence for Registered Scientist, or RSci, which is intended for people with a few years' experience, working in more senior roles.

Evan Rodden, IOP Accreditation and Technicians Officer, said: "Obtaining professional registration brings you closer to the physics community. In addition to using the post-nominals RSciTech or RSci, you will become a member of the IOP, giving you access to scientific conferences and events, special interest groups and our monthly member magazine, *Physics World*."

Applicants for either registration need to demonstrate competencies across a number of different areas, demonstrating that you have the level of knowledge and competence required for your role, as well as a commitment to the continuous professional development necessary to keep you at the



Becoming a Registered Technician recognises the vital role that technicians play in the classroom.

**Salter's Registered Technician Awards**

Nominate a technician for a £1000 award. Closing date 6 May.

Visit [saltersinstitute.co.uk/awards/technician-awards](http://saltersinstitute.co.uk/awards/technician-awards).



**Salter's Institute**

cutting edge of your profession. Assessment takes place either online or by interview.

Current IOP registered technicians include a technician at Loughborough University and a technician at Diamond Light Source.

**For more information:** on professional registration or membership of the IOP, please email [evan.rodden@iop.org](mailto:evan.rodden@iop.org) or call 020 7470 4828.

**Teacher recruitment**

## Physics teacher trainee numbers increase 14%

The future of physics in schools continues to look promising as the number of subject-specialist trainees continues to rise.

Figures from the Department for Education (DfE) show that 851 graduates were accepted onto initial teacher training courses specialising in physics for 2016/2017. This is 105 more than last year and the third highest ever – a significant improvement on the mere 224 recruits in 1999 and the 30-year average of around 400.

Chris Shepherd, the IOP's Teacher Support



Some of the 2014/2015 IOP scholars as they prepared to start their training.

Manager (Initial Teacher Education) said that the continued increase was very welcome, but added, "There is still much work to be

done. Many schools still struggle to recruit anyone with a physics specialism. In order for all schools to have the physics teachers they require, at least 1,000 new specialist teachers must be recruited each year for the next decade. New measures to reduce teacher attrition are also vitally necessary."

The IOP offered 150 Teacher Training Scholarships in the last academic year, with each successful applicant receiving £30,000 tax-free funding from the DfE to support them during their training.

**For more information:** about IOP support for student teachers, visit [bit.ly/learning-toteachphysics](http://bit.ly/learning-toteachphysics). Info on IOP scholarships at [iop.org/scholarships](http://iop.org/scholarships).

**Teacher recruitment**

## Free website could help you find physics specialist

A teacher recruitment site that costs schools nothing to use could be a particular boon to physics departments.

Professor John Howson, Oxford Brookes expert on the teacher labour market, co-founded TeachVac to transform teacher recruitment. He believes that some schools

spend more than £100,000 on teacher recruitment annually and estimates that TeachVac could save schools collectively over £50 million a year.

"The site allows schools to advertise for a physicist one week and a teacher of science the following week, all at no cost," he said. "Schools can see how many responses they receive to an advertisement for a physicist before widening their search. Financial pressures in the route of paid advertising mean most advertisements are for a teacher

of science. The school's desire for a physicist is often buried in the small print." Teachers, returners and trainees also pay nothing to register to be notified of vacancies daily.

Professor Howson is a well-known blogger. He uses anonymised statistical data that the site generates in his research and also uses it to fund the site itself.

**For more information:** visit TeachVac at [teachvac.co.uk](http://teachvac.co.uk). Follow Professor Howson's blog at [johnohowson.wordpress.com](http://johnohowson.wordpress.com).



Teaching resources

# Make a song and dance about physics

Remembering song lyrics can be a lot easier – and more fun – than remembering pages of textbooks. So we've teamed up with self-styled science troubadour and pioneer of geek pop Jonny Berliner to create a set of resources to help get your physics classes singing – and storing learning in song-form.

Jonny explained that students will relish the opportunity to be immersed in their favourite music in the classroom. But they will also be immersed in physics: "By condensing concepts into short lines of lyrics, students are forced to develop understanding to a point where they can reproduce it succinctly. This fosters deeper understanding than rote learning and gives the students ownership of their revision materials."

The lesson plans and presentations will cut the preparation time that may put teachers off this sort of activity – and reassure those who are concerned about their musical ability. They should enable



Science teacher and musician Jonny Berliner sings the electromagnetic blues.

you to get a class to write a song in just one lesson or to set it as homework.

Cheat sheets will help students structure the song and classes can be split to share the writing. There is an example song on electromagnetic waves.

"Of course, some students will be too

cool to sing along," admits Jonny. "But in my experience, they are often still enjoying the experience and getting those catchy educational lyrics stuck in their head."

**To download Jonny's resources visit:**  
[iop.org/songresources](http://iop.org/songresources).

Teaching resources

## 30 ideas for 30 years of CREST

The British Science Association has published *30 Inspirational Ideas* to celebrate 30 years of their CREST awards.

The resource contains submissions from teachers, students and STEM professionals and includes tips for running STEM clubs and CREST projects, hands-on activity ideas and suggestions for outside the classroom.

Earlier this year, the BSA published a report from Pro Bono Economics which revealed that students who have taken a CREST Silver Award achieved half a grade higher on their best science GCSE result and were more likely to continue with STEM education, compared to a matched control group.

To complete CREST and receive an award, students can do a range of classroom and external activities. For example, some IOP teaching resources, such as Exoplanets, are approved towards CREST, whilst participants in the National Space Centre rocket-building workshop are eligible for a CREST award.

In their 30 years, more than 400,000 students have received CREST awards, and more than 30,000 5–19 year olds a year now submit for an award.

**Download 30 Inspirational Ideas at:**  
[britishscienceassociation.org/news/crest30](http://britishscienceassociation.org/news/crest30). IOP Exoplanets resources are at [iop.org/exoplanets](http://iop.org/exoplanets).



British Science Week 10–19 March



Check out our teaching tip on the back page, which you can use on Demo Day during British Science Week: [britishscienceweek.org](http://britishscienceweek.org).

Student experiences

## Lab in a Lorry reaches end of Welsh tour

The current tour of Lab in a Lorry comes to an end in March, having welcomed more than 20,000 pupils from over 100 schools in Wales since 2013. This is the third full-time tour of Wales.

The lab is aimed at pupils from KS3. It has been supported by the National Science Academy, enabling schools to host it free of charge for up to four days.

James Bamford, the senior operations co-ordinator for the Lab, thanked all those involved: "We are supported by volunteers who give their expertise and guide the pupils through the open-ended experiments on board, covering topics such as resonance, optoelectronics, particle physics and the electromagnetic spectrum. By creating links with the local volunteers and using our post-visit resources, many schools create partnerships that continue long after their event, enabling more pupils to engage with physics in a different way to the classroom."

Lab in a Lorry was co-founded by the Institute of Physics in 2004 and has had a variety of partners. It has toured the UK and Ireland, and hopes to continue. An external evaluation report will be published in April.

**For resources and experiments visit:**  
[labinalorry.org.uk/experiments.html](http://labinalorry.org.uk/experiments.html).



STIMULATING  
**PHYSICS**  
NETWORK

### Teaching KS4 Physics with Confidence: Forces

George Spencer Academy, Nottingham,  
7 June

Join us for a workshop suitable for non-specialists, early-career teachers and anybody wanting fresh ideas for delivering forces at KS4. We will focus on the required practicals and also maths issues like vectors, equations and graphs. Book your place: [bit.ly/teachKS4phys](http://bit.ly/teachKS4phys).

### SPN Summer Schools 2017: Registration now open

We are holding three residential CPD events in 2017 to support the teaching and learning of physics. These no-cost courses are available to all non-specialist physics teachers:

- 31 July – 3 August at Homerton College, Cambridge.
- 7–10 August at Keble College, Oxford.
- 29 August – 1 Sept at the National Science Learning Centre (NSLC), York.

The programme will include practical workshops, discussions and masterclasses covering energy, electricity, Earth in space, forces and sound, along with inspiring guest speakers and social activities. Places are filling fast, so book your place at: [stimulatingphysics.org/summer-schools](http://stimulatingphysics.org/summer-schools).

### Activities this winter across the regions

- Newland School for Girls became our latest Partner School in Yorkshire and the North East.
- 60 teachers attended January's regional day for teachers of physics in Leeds.
- Davison Church of England High School for Girls in Worthing became our latest Link School in the South.
- Devinder Gill, David Harries and Liz Amos joined the mentoring team in Yorkshire, the North East and Midlands.
- Teaching and Learning Coach Graham Perrin led a session, Teaching Electricity with Confidence, at Formby High School in the North West.

### Community



Follow us @TakeOnPhysics for advice, ideas and events for teachers of physics.



## Academic resilience

# Boosting resilience boosts physics

Over the last two years, the Institute of Physics' Improving Gender Balance



project has been looking at how schools can boost academic resilience.

Our research indicates that a lack of resilience in physics may be a particular issue for female students and may contribute to the low proportion of girls sticking with the subject post-16. Although the project focused on girls, teaching methods that aim to boost resilience are likely to benefit all students, and may be especially valuable for physics, which is often perceived as a "hard" subject.

Students with a high level of academic resilience tend to achieve highly despite setbacks, and do not give up if they fail. Research shows that academically resilient

students share similar feelings: competency (feeling able to succeed); potency (feeling able to identify strategies); optimism (feeling positive); usefulness (feeling needed); and belonging (feeling valued). Students who don't share these feelings may be easily discouraged, even if they have a strong academic record.

Nicky Thomas, the IOP's Improving Gender Balance project officer, said, "Once you realise that resilience is linked with a student's individual feelings (however unrealistic), it's easier to understand why students react differently to the same interactions. Simple tweaks to your classroom practice can encourage resilience in your students."

**For more information:** watch the TalkPhysics webinar on promoting resilience and growth mindsets [talkphysics.org/growth](http://talkphysics.org/growth).



There are a phenomenal 42 physicists in the sixth form at the girls-only Kendrick School in Reading.

## Girls in physics

# Gender equality kitemark pilot launched

A gender equality kitemark for schools is being trialled in 12 London schools



as part of a pilot project by the IOP in partnership with King's College London.

"There are still subjects and behaviour traits that are seen as 'for boys' and 'for girls'," says Jessica Rowson, IOP Gender Balance Manager pre-19. "To tackle gendered difference in subject choice and achievement, we need to look at what is happening in the whole school environment."

The Opening Doors Charter pilot follows IOP research which indicates that whole school gender equity projects are likely to have a positive impact on the proportion of

girls taking A-level physics.

So we have put together a set of criteria that schools would need to meet to qualify for the kitemark. The pilot schools will go through a self-evaluation process to assess their practice against the criteria. With the support of an IOP mentor, they will identify any areas where improvements can be made and put plans in place for the future.

Schools will then take part in a rigorous evaluation process to determine how useful they found the process and to identify future benefits, as well as barriers, that schools faced during the project. If the evaluation indicates that the scheme is successful, we hope to roll out a national programme.

**IOP gender resources and newsletter:** at [iop.org/genderresources](http://iop.org/genderresources). Join the discussion at [talkphysics.org/groups/whole-school-equality](http://talkphysics.org/groups/whole-school-equality).



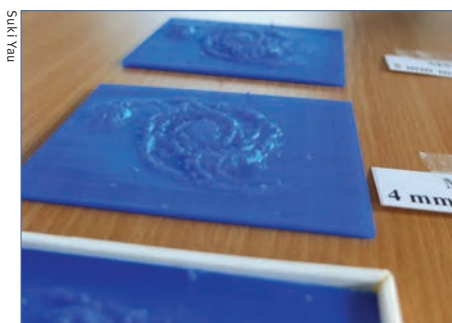
## SEN resources

# Astronomy project reaches blind and visually-impaired students

Physics teachers of blind and vision-impaired students may be interested in a new project at the University of Portsmouth's Institute of Cosmology and Gravitation.

Called "The Tactile Universe", the group aims to develop astronomy outreach activities using tactile and audio representations of real astronomical data.

Nic Bonne, the project's principle investigator, invites teachers who might be interested to get in touch. He added, "Our final goal is to make all of our resources available for free under a Creative Commons licence. This will allow others around the country, and eventually internationally, to more easily run their own version of our activities."



A prototype 3D printed galaxy image.

**For more information:** visit [icg.port.ac.uk/tactileuniverse](http://icg.port.ac.uk/tactileuniverse) or see Twitter at [@TactileUniverse](https://twitter.com/TactileUniverse). If you, or anybody you know, would benefit from this project or like to be involved, please email [nicolas.bonne@port.ac.uk](mailto:nicolas.bonne@port.ac.uk) or phone +44 (0)2392 845158.

## Student resources

# Tackling global problems using physics

How can we use physics to try and solve the problems affecting our world? The Royal Society, British Council and Commonwealth Secretariat have produced a set of free resources to encourage young people, aged 7–14, around the world to consider and investigate some of the long-term global problems that scientists are working on, but have not yet solved.

The pack consists of four units that develop knowledge, skills and principles from across the scientific disciplines, each linked to one of the United Nations Sustainable Development Goals. Physics topics include renewable energy sources and the engineering challenges of rising sea levels and food security.

**For more information:** visit [bit.ly/BCscience](http://bit.ly/BCscience) or email [education@royalsociety.org](mailto:education@royalsociety.org).

## Marvin and Milo

# Eggstraordinary

Marvin and Milo are the Institute's resident cat and dog experimenters. Every month, they come up with a new easy demo at [bit.ly/IOPmandm](http://bit.ly/IOPmandm).

**DO NOT TRY THIS AT HOME**  
#58  
Featuring: Marvin and Milo

**What you need:** • Raw egg • Large pop bottle • Salt • Scissors • Sticky tape • Water

Watch me drop this egg without it smashing!

Cut the top off the bottle and put the egg inside.

Fill the bottle with enough water so that the egg is well covered.

Add salt to the water, stirring, until the egg floats.

Tape the top of the bottle back on.

Drop the bottle to the floor from waist height.

The egg doesn't break because the salt water spreads the impact across the whole egg. Try dropping the egg in the bottle without the salt water.

Vic Le Billion  
www.physics.org search term: impact

### What you need

- Raw egg
- Large pop bottle
- Scissors
- Sticky tape
- Water
- Salt

### Instructions

1. Cut the top off the bottle and put the egg inside.
2. Fill the bottle with enough water so that the egg is well covered. Add salt to the water, stirring, until the egg floats.
3. Tape the top of the bottle back on. Drop the bottle to the floor from waist height.

### Results and explanation

The egg doesn't break because the salt water spreads the impact across the whole egg. Try dropping the egg in the bottle without the salt water.

# talkphysics

Our online discussion forum for teachers of physics, technicians and teacher supporters.

## Physics demos with five-pound notes

“I was really pleased to find a relatively new, old five-pound note in my change today,” posts Dave Cotton, a teacher from Preston who is also an IOP Physics Network Co-ordinator. “I think they will diminish over the next year and you should really keep a few back. The first thing I usually do with money is to shine UV on it.” Find out his other suggestions by logging in and following his thread.

- Posted in the *Talking Physics* group at [bit.ly/TP5pound](http://bit.ly/TP5pound).



## Classic physics papers for A-level

This thread will be of interest to teachers of post-16 students – or teachers themselves. A-level teacher Ben wanted to make a list of influential physics research papers that were understandable by A-level students, such as the papers Einstein published in 1905 or Fermi’s *Nature* paper. The thread produced an impressive collection, including the top-10 most-cited physics papers.

- Posted in the *News & Comments* group at [bit.ly/TPclassics](http://bit.ly/TPclassics).

## Non-specialist asks about thermal radiation

“As a non-physicist I am a bit confused. Do all objects give out thermal radiation or just objects that are hotter than their surroundings – for example does an

ice cube in a warm room still give out thermal radiation?” Andrew’s question drew responses from several experienced specialist teachers, and after asking more questions, he posted: “Having just joined the site yesterday I have been really pleased with how much people’s responses have helped me. I love teaching physics but as a

non-specialist I have gaps in my knowledge and my knowledge is not as deep as I would like – however, I feel really excited now knowing that I can ask questions here and have the time to digest responses and places for further reading.”

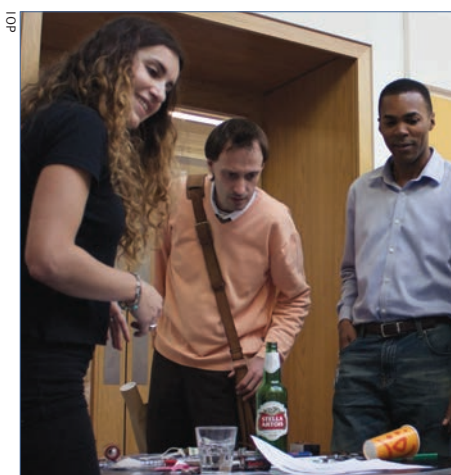
- Posted in the *Teaching Physics 11–14* group at [bit.ly/TPthermal](http://bit.ly/TPthermal).



Read about the work of, and life at, the Institute of Physics. Get news and comment from IOP staff and members. And check out our analyses of data on physics in education, research and industry.

## Supporting other teachers

Niloufar Wijetunge has been a physics teacher for nearly 20 years and an IOP Physics Network Coordinator supporting teachers for 10 years. Her teacher training taught her how to teach students but now she is studying for a master’s degree in Teacher Education so that she can formalise her training in teacher support. Her blog describes how this new level of training has influenced her work, both in the classroom and in facilitating teacher CPD.



- [iopblog.org/learning-to-support-other-teachers-is-rewarding-and-useful](http://iopblog.org/learning-to-support-other-teachers-is-rewarding-and-useful).

## A poetic view of William Rowan Hamilton

This report of an IOP evening of physics and poetry will appeal to teachers with an interest in the history of physics. The 19th-century mathematical physicist Hamilton was himself something of a poet. This inspired poet and physicist Iggy McGovern to write a book based on his life with poems written as if from the perspective of 54 people whom Hamilton knew, and two whom he influenced long after his death: Irish rebel and politician Eamon de Valera, a devotee of his algebra, and physicist Erwin Schrödinger. Hamilton was made the Andrews Professor of Astronomy at Dublin University aged just 22. He predicted conical refraction and corresponded with some of the most celebrated authors and poets of his day. He also lived through turbulent political times, and flirted with the Oxford Movement in the Anglican Church – apparently he really did attempt to calculate the velocity of Christ’s ascension!

- [iopblog.org/history-of-physics-group-becomes-well-versed-on-william-rowan-hamilton/](http://iopblog.org/history-of-physics-group-becomes-well-versed-on-william-rowan-hamilton/).

## Talking to students about stereotypes

“For young people, who are still making sense of the world and who are making decisions about their future, stereotypes can restrict their choices. From an early age, certain professions are seen as for

boys or for girls – nursing, engineering, the armed forces. By having discussions with students about stereotypes, we can open their minds to other opportunities and paths.” Rebecca Peacock, an IOP Gender Balance Officer, offers lesson plans and resources to tackle stereotypes.

- [iopblog.org/talking-to-students-about-stereotypes](http://iopblog.org/talking-to-students-about-stereotypes).



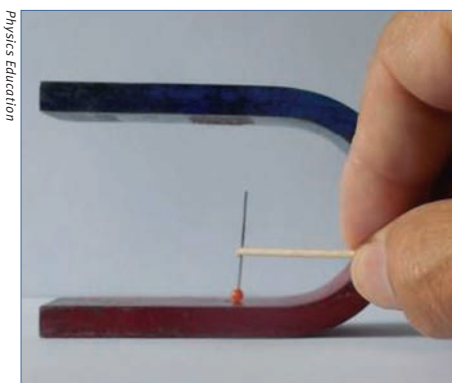
# Physics *education*

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## Experiments with a U-shaped magnet

The humble U-shaped or horseshoe magnet has more to offer from a practical perspective than you might think. This paper has some beautiful ideas just using pins and other inexpensive items most schools will have already. Some are suitable for 14–16 year olds but the majority are aimed at 16–18 students. For investigation inspiration, these sliding and oscillating pins are certainly worth considering.

● By Miloš Babović and Vukota Babović in the January 2017 issue: [bit.ly/PEdmagnetsJan17](http://bit.ly/PEdmagnetsJan17).



## Using the Drude model of electrical resistance

By analysing the Drude model, this paper has all the theory behind a model of resistance and explains how that model can be physically realised using slotted masses, marbles and ramps. This is a model you can use in a simplified form from 11–14, but it also allows older students to explore the effect of altering the crystal structure or density of conduction electrons on the resistivity.

● By Dan Cottle (IOP Teaching and Learning Coach) and Rick Marshall in the September 2016 issue: [bit.ly/PEdrudeSep16](http://bit.ly/PEdrudeSep16).

## DIY soundcard-based logging system

This paper enables schools to make their own low-cost temperature logging instrument and learn about its calibration in the process. It

includes simple applications for using logging systems to monitor simple heat experiments and explains how the data obtained can be analysed to gain insights into the physical processes. The datalogger uses Virtual Physical Laboratory (VPLab) software that is free to schools in the UK and Ireland who

attend IOP Teacher Network workshops. If you already have a computer that runs VPLab, you only need thermistors, wire and audio jacks.

● By John Nunn (National Physical Laboratory) in the November 2016 issue: [bit.ly/PEdiyNov16](http://bit.ly/PEdiyNov16) and [bit.ly/PEdiy2Nov16](http://bit.ly/PEdiy2Nov16).

# physicsworld

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## The journey of a crisp

Join the author on a tour through the world's largest crisp factory – PepsiCo's Walker's plant in Leicester – and discover how physicists are perfecting the transformation of potatoes in our favourite salty snack. The article details the myriad of ways physicists have helped fine-tune the production of crisps through researching new processes to both improve efficiency and ensure consumers can be guaranteed a high-quality product.

● By Louise Mayor in the November 2016 issue: [bit.ly/PWcrispNov16](http://bit.ly/PWcrispNov16).



## Seeing single photons

The decades-old question of whether humans can see individual photons is on the brink of being answered thanks to advances in quantum optics. The author details a research project currently underway at the University of Illinois that is a collaboration between psychology and physics. The project is studying how the human visual system responds to extremely small amounts of light and discusses how this may allow us to use human observers as “detectors” to explore quantum effects such as entanglement.

● By Rebecca Holmes in the December 2016 issue: [bit.ly/PWphotDec16](http://bit.ly/PWphotDec16).

## Penguin physics

“I'm often asked how as a physicist I managed to end up carrying out research on penguins. The answer is it happened through a set of lucky chances driven by my partner's passion for these animals.” Twenty years ago, polymer physicist Peter Barham found

himself at the Third International Penguin Conference in Cape Town. It was his first biological science conference and it made a striking contrast to the physics meetings he had previously attended. But in the course of discussions on the aftermaths of an oil spill, he realised his knowledge of plastics might enable the development of new plastic flipper bands to replace the metal markers that were

proving harmful. Thus he became a polymer physicist researching penguins and his work has led to global changes in the way oiled birds are rehabilitated. This is a fascinating insight into the world of penguin conservation and the reflections of a physicist who finds himself amongst biologists.

● By Peter Barham in the December 2016 issue: [bit.ly/PWpengDec16](http://bit.ly/PWpengDec16).

## EVENTS FOR TEACHERS

### Maths for KS3/4 Physics – New Approaches

Burgate School, Fordingbridge, Hampshire  
9 March

This workshop will look at providing strategies for students to increase their understanding and reduce fears around the increased amount of maths in the science curriculum. Details and booking: [bit.ly/PhysicsandMaths](http://bit.ly/PhysicsandMaths).

### Isaac Physics – an Introduction

Tunbridge Wells Grammar School for Boys, Kent  
14 March

An introduction to Isaac Physics – a free online resource developed by Cambridge University to support you in assessing and stretching your A-level students. Details and booking: email Darrell Hamilton on [dahp.twggs@gmail.com](mailto:dahp.twggs@gmail.com).

### Astro Academy: Principia

15 March Winchester Science Centre  
16 March and 4 July Framwellgate School, Durham  
26 April and 6 July St Wilfrid's RC College, Newcastle  
26 April University of Leeds  
Free twilight CPD introducing the Astro Academy: Principia programme, based on Tim Peake's experiments aboard the International Space Station. To book or for more information, email [nsa@spacecentre.co.uk](mailto:nsa@spacecentre.co.uk) or call 0116 2582 147.

### Technicians Supporting A-level Physics

National STEM Learning Centre, York  
18 May

This residential course will explore a number of topics relevant to technicians and introduce a range of practical ideas that link into the current specifications. Details and booking: [bit.ly/TechniciansResidential](http://bit.ly/TechniciansResidential).

### Rockets Make and Take

Tunbridge Wells Grammar School for Boys, Kent  
23 May

Learn how to build your own rocket-launcher and how to develop a student activity around the rocket's flight path. Details and booking: email Darrell Hamilton on [dahp.twggs@gmail.com](mailto:dahp.twggs@gmail.com).

### IOP Stirling Meeting & SSERC Scottish Physics Teachers' Summer School

## STUDENT COMPETITIONS



The winner of last year's under-16 Weather Photographer of the Year: James Bailey.

### Weather Photographer of the Year 2017

The Royal Meteorological Society and the Royal Photographic Society do not require fancy equipment or an exotic location – most short-listed entries from last year's competition were taken in the UK on smartphones or compact cameras. The deadline for this year's entries is 15 May 2017. More details: [weather-photo.org](http://weather-photo.org).

### 2017 NPL School Science Film Challenge

Students are invited to make and submit a film, less than two and a half minutes long, describing or demonstrating an aspect of science correctly and in an engaging way. Prizes are awarded for various categories, for best school entry (£500) and for best film made by an independent (of school) team, including a student (£300). Entries must be submitted by 30 April. More details: [bit.ly/NPLFilm](http://bit.ly/NPLFilm).

### Shell Bright Ideas Challenge

A cross-curricular competition inviting students aged 11–14 to use their STEM expertise, team work, creativity and problem solving to imagine innovative solutions to power cities of the future. Videos and free classroom resources online to support teachers in delivering the challenge. Regional and national prizes worth up to £3,500. Deadline is 21 April. More details: [shell.co.uk/brightideaschallenge](http://shell.co.uk/brightideaschallenge).

SSERC, Dunfermline and various venues  
24–27 May

The annual meeting of the Scottish physics teaching community will focus on changes to the curriculum and cutting-edge physics. A small group go on for another three days at the Summer School. Details and registration at [stirlingmeeting.org](http://stirlingmeeting.org) and [www.sserc.org.uk/book-courses-online](http://www.sserc.org.uk/book-courses-online).

### Improving Gender Balance

Burgate School, Fordingbridge  
8 June

This workshop will look at the steps schools can put in place to make education more equitable as well as exploring the effect of unconscious bias and why it is important to address it within the school environment. Details and booking: [bit.ly/IGBworkshop](http://bit.ly/IGBworkshop).

### Preparing to teach physics

National STEM Learning Centre, York  
9 June

A residential course addressing some of the common misconceptions students have and utilising current research to provide strategies to overcome them. It will also cover demonstrations and practical activities. Details and booking: [bit.ly/PreparingToTeach](http://bit.ly/PreparingToTeach).

### Annual South West Physics Day

University of Exeter  
23 June

This popular CPD day features a mix of practical workshops, inspiring talks and congenial networking. Sessions will include ideas for those new to physics teaching as well as the more experienced. Details and booking: [stimulatingphysics.org/south](http://stimulatingphysics.org/south).

### A Day for Everyone Teaching Physics

The Sjøvoll Centre, Durham  
30 June

Lectures, masterclasses, workshops and more. All teachers of physics, technicians and trainees welcome. The event is funded by IOP and free to participants. For information and registration: [bit.ly/DurhamTeacher](http://bit.ly/DurhamTeacher).

## GRANT DEADLINES

### IOP School Grants

One-off grants of up to £600 for projects or events linked to teaching or promoting physics and engineering in UK schools and colleges. 2017 deadlines: 1 June and 1 November. More information and application forms at [iop.org/schoolgrants](http://iop.org/schoolgrants).

### Anthony Waterhouse Fellowship

Do you have an idea about physics teaching that you have always wanted to develop? These fellowships provide grants of £2,000 plus support from the IOP to help you develop your idea. Applications close 17 April. More information and application forms at [iop.org/waterhousefellowship](http://iop.org/waterhousefellowship).

## Answers to "Careers from physics" crossword on page 11

**ACROSS:** 2. Architect; 4. Surgeon; 7. Sports engineer; 9. Journalist; 10. Patent attorney; 11. Visual effects artist; 12. Astrophysicist  
**DOWN:** 1. Meteorologist; 3. Game designer; 5. Medical physicist; 6. Structural engineer; 8. Teacher



# Careers from physics

Continuing with physics at the age of 16 is the first step towards many careers. How many can you name?

Fill in the crossword using the clues provided.

**ACROSS**

- Plans the construction of buildings (9)
- A doctor who carries out operations (7)
- Develops technology for high-level athletes (6, 8)
- Writes for newspapers, magazines, etc (10)
- Legally protects new inventions (6, 8)
- Creates virtual worlds for film and TV (6, 7, 6)
- Researches the nature of celestial bodies (14)

**DOWN**

- Studies the weather and climate (13)
- Ensures realistic physics in computer games (4, 8)
- Applies physics to the field of healthcare (7, 9)
- Makes sure built structures can withstand their environment (10, 8)
- Educates the next generation (7)

## IOP Institute of Physics



Teachers: see page 10 for crossword answers

This teaching tip comes from resources for this year's British Science Week (10–19 March). For more ideas for Demo Day (16 March), visit [britishscienceweek.org/plan-your-activities/demo-day](http://britishscienceweek.org/plan-your-activities/demo-day).



## CHANGING STATES ERUPTING FIZZ WITH THE INSTITUTE OF PHYSICS

### Toolkit

- Large glass
- Fizzy drink – preferably a clear one
- Vegetable oil
- Food colouring
- An Alka-Seltzer tablet
- Some salt
- Stirrer



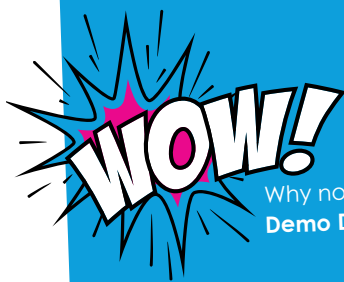
### About this activity

Turn simple household ingredients into a foaming eruption, like that of a volcano!



### Watch out!

Ensure you protect your workspace and clothes during this experiment.



Why not try this for Demo Day?

### Part 1 Get fizzy

Half-fill the glass with the fizzy drink and then pour vegetable oil into the glass so that it is roughly two-thirds full. Add a few drops of food colouring and stir the mixture. Wait until the two layers have clearly separated.

Add approximately two tablespoons of salt to the liquid in one go. A great foam eruption will occur. Observe the liquids after the eruption has settled down. You should be able to see a lava-lamp-style bubble effect.

Add an Alka-Seltzer tablet to the liquid. You should see some interesting bubbling effects from the gas given off by the Alka-Seltzer, and the change in the speed of those bubbles as they travel through water versus oil.

### Part 2 Keep it fizzing

This trick can keep working for quite a while if you add more Alka-Seltzer. You won't see the big fizzy eruption once the drink loses its fizz, but the bubble effect is still very clear.

Make sure that your fizzy drink isn't too dark to allow you to see the bubbles passing through the liquid.

### Part 3 Think about it

Consider the following affects you have observed:

- Why don't water and oil mix well?
- Why does adding salt to a fizzy drink cause a foamy eruption? What gases are being creating?
- Why, when the Alka-Seltzer is placed into water, does it start fizzing?
- Why do the bubbles travel at different rates through the different layers?

### Next steps

Find more activities and resources on the Institute of Physics website [physics.org/discover](http://physics.org/discover)



**IOP** Institute of Physics