IOP Institute of Physics
Education Supporting Teachers

Classroom Physics 10th anniversary 2007–2017

Classroomphysics

The newsletter for affiliated schools

June 2017 Issue 41

Resources

RAF100: commemorate and inspire

Next year, the Royal Air Force will be celebrating its centenary. The IOP is delighted to be collaborating with it, and the Historical Association, on the RAF100 Schools Project.

Ever since its creation in 1918 the Royal Air Force (RAF) has played an important role in British history. Central to its success has been its work at the cutting edge of innovation and technology.

The RAF100 Schools Project is a national scheme that uses the story of the RAF to explore concepts in both history and physics.

The project offers teachers and students an excellent opportunity to investigate how history and physics are interlinked, showing how human need has driven scientific developments in areas such as computing, radar and stealth technology. At the same time it will show how physics can be instrumental to humanitarian efforts such as disaster relief. All this has shaped our society in the past – and will continue to do so in the future.

"This collaboration is exciting for the Institute," said Taj Bhutta, IOP Schools Support Manager. "It is the first time we've developed a resource to showcase the applications of physics in the contexts of both society and history. The RAF has driven developments in many areas of science engineering, which have been applied far beyond their original military context. We are looking forward to supporting young people from all backgrounds in investigating these developments for themselves and researching how they have impacted their local community."

Schools will be encouraged to work with their local communities to commemorate and celebrate the achievements of the men and women who have been part of the RAF over the last 100 years. They will be invited to run projects throughout the 2017/18 academic year. The project will provide resources to support activities, including videos, interactive maps, case studies, local events for students and regional CPD for teachers.

Students will be encouraged to upload and share their own investigations and experiments on the RAF100 Schools website and, by doing so, will be able to enter into a competition that will see the winners invited to conferences and national RAF100 Schools Project events.

How to get involved: register your interest by visiting raf100schools.org.uk. To find events near you, visit raf.mod.uk/raf100/whats-on.

RAF aircraft past and present: a Spitfire from the Battle of Britain Memorial Flight with a 3 Squadron Typhoon in formation over Lincolnshire.

The history of the RAF

The Royal Air Force was formed as a separate service, independent of the British Army and Royal Navy, on 1 April 1918. It was the first time that any country had formed an entirely separate and independent air force. This new RAF was the most powerful air force in the world, with more than 290,000 personnel and nearly 23,000 aircraft, and fought effectively from April 1918 onwards over the Western Front in support of ground forces. For more important dates in the history of the RAF, visit raf.mod.uk/raf100/timeline.

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

In this issue

Editorial

We hope you enjoyed the special 10th anniversary edition of *Classroom Physics*. We invited back previous editors to a small celebration in March – yes, there was cake!

From left to right: Caroline Davis, Clare Thomson, Manchi Chung and Ellen Phillips.

Welcome to the summer issue of *Classroom Physics*.

We are delighted to include a copy of our new report **Improving Gender Balance: Reflections on the impact of interventions in schools** (see page 3). It's an exciting read – and not just for your science department. The problem of how to increase the number of girls carrying on physics post-16 has been a stubborn one. But this report demonstrates an approach with the potential to begin real change. Taking a whole-school approach is a significant undertaking, but the positive outcomes may be welcomed well beyond physics in other subjects that may not have considered they have a gender balance problem.

Affiliated schools will also receive two careers leaflets. The first is the new Tomorrow's Engineers careers leaflet, **From idea to career**. It explores 12 areas of engineering, from aeronautical to manufacturing, and gives advice on what options to choose at school and training routes.

A second leaflet, **Making a Difference: Physics and Engineering Careers in Medicine and Biology**, comes from IPEM, the Institute of Physics and Engineering in Medicine. It includes career profiles plus info on expected salaries.

Do get in touch with any thoughts on this issue's contents.

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Photography by **Daniel Josman**

Education policy

Meet our Vice-President, Education: Dr Carol Davenport

Carol joined IOP Council last year. She has taught physics and worked as a teacher educator for more than 20 years – you may have met her as an IOP Teaching & Learning Coach or Physics Network Co-ordinator. She is currently director of NUSTEM (formerly Think Physics) at Northumbria University.

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Who was your favourite physics teacher?
Mr Duffy. He was happy to let me sit in his physics lab at lunchtime. I remember bringing in some old slides my dad had and being allowed to use the school microscopes to look at them. Mr Duffy put up with 12 year olds asking him random questions – sometimes about science – while he was trying to get on with his work.

Why did you become a physics teacher?
In the last year of my PhD I decided that I wanted to make a difference in education. I wanted to influence teaching through education policy and realised that I should have experience of teaching. I enrolled on a PGCE exclusively for further education, because I was pretty sure I didn't like children – thankfully, it turned out that wasn't the case!

What are your favourite classroom activities?
One would be Lenz's law, where you drop a magnet down two tubes – one plastic and one copper. It takes much longer for the magnet to fall through the copper tube. The other uses two ice cubes and some foil. At the start of the lesson I wrap one cube in foil and leave the other unwrapped. Very rarely would students predict that the cube wrapped in foil would melt much more slowly than the unwrapped one.

How can teachers best improve their students' experience of physics?
I encourage teaching a topic using contexts – where or how physics is used – before moving onto teaching the concepts of the topic. Plan your illustrations because otherwise you'll fall back on the standard examples, which may not appeal to the different interests of the 30 students in your class. For example, if you're teaching circuits and sensors, introduce the topic using temperature control in incubators for premature babies.

Why did you join IOP Council?
I've benefited from IOP support and I wanted to give something back. It gives me the opportunity to support the strategic development of the Education Department of the IOP and therefore to influence the quality of physics education.

What does the IOP offer to teacher members?
The IOP provides so much for UK schools. Membership allows teachers to support and influence that and also to be part of a wider community of physics. It can also help teachers to keep their own subject knowledge up to date, which can only improve their teaching.

For more information: IOP members can get involved with our education policy by joining the Education Forum at iop.org/educationforum. More about NUSTEM at nustem.uk. Carol has provided this issue's **Teaching Tip** on the back page.

IOP news

Hoardings featuring work by local schoolchildren have been installed at the site of IOP's new London home in King's Cross. We have just finished the demolition phase of the project and are beginning construction. Join us on our journey to King's Cross at kingscross.iop.org.

Improving gender balance

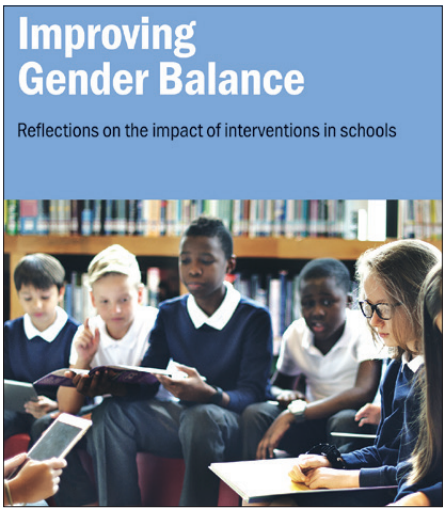
Opening doors with a fresh approach

In March we launched the findings of our three-year study into the lack of girls choosing physics – and the outcomes of a new approach to tackling it.

"The number of girls taking A-level physics in England has remained around 22% for the last 30 years. The failure of numerous initiatives to make a revolutionary impact has meant that something new was needed," IOP Head of Education Charles Tracy said at the launch. "This is outlined in our report, *Improving Gender Balance: Reflections on the impact of interventions in schools*."

This new approach saw a dramatic rise in the targeted schools, from 10% to 27%, exceeding all previous interventions. It used a blended technique, working with students, physics teachers and the whole school staff.

"Each intervention has an effect on its own but it was by blending all three that we saw a potentially transformational change in uptake," Charles said.



The launch of the report was a well-attended and thought-provoking day. Attendees heard directly from teachers involved in the project. One described the impact of girls-only science clubs. Another worked with year-10 groups to create an expectation they would take physics A-level. The need to obtain buy-in from senior leadership teams was also discussed.

Other themes emerging were the importance of consistent mentoring, recruiting and retaining high-quality teachers and that stereotyping was an issue for both sexes.

We are now working with partners to develop a gender-equality mark and a framework to help schools tackle inequalities in the school system as well as rolling out the findings through the Stimulating Physics Network.

For more information: catch up on the event at storify.com/PhysicsNews/improving-gender-balance, #iopequality, bit.ly/videoIGB and bit.ly/blogIGB. Affiliated Schools will have received the full report, which can be downloaded at iop.org/genderreports.

Diversity

Supporting students with colour vision deficiency

Did you know that you are likely to be teaching children today who are colour blind? In a co-ed class of 30, at least one child is likely to have some form of colour vision deficiency and as many as one in 12 boys is affected. Our new report *Supporting Students in STEM with Colour Vision Deficiency* outlines strategies that can be adopted to ensure that such children are not disadvantaged.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How someone with normal vision sees coloured pencils (left) and with red-cone deficiency (right).

For more information: visit colourblindawareness.org.

Download the report at: bit.ly/IOPdivreports.

Inclusive teaching and learning

This IOP report may be useful to schools who are considering their own physics provision for SEND students and what is possible for SEND students wishing to study physics at university.

Building Momentum sets out the progress that university physics departments are making to provide a more inclusive learning environment and breaking down barriers to disabled students. It also draws on the experiences of more than 250 disabled IOP student members.

Download the report at: bit.ly/IOPdivreports.

Professional development

Is your school a CPD award winner?

The IOP Best Practice in Professional Development Awards commends, celebrates and promotes the very best in training and development opportunities for physicists. Enter your school or college for an award by Friday 30 June 2017.

If your school or college promotes the continuing professional development of you as a physics teacher, enter now to get the recognition your employer deserves. Nominations are welcomed from schools and colleges of all sizes.

The award demonstrates your school or college's commitment to the vital role physics has to play in our society. Previous winners include The Hewett School, Sellafield Ltd and EDF Energy. Winners of the award have benefited greatly from staff training opportunities through professional recognition, gaining chartered physicists status.

Awards are presented at the Institute's prestigious annual awards dinner, and winners are profiled on our website and in our publications.

Further details on how to apply: available on the IOP website at iop.org/bestpractice. We look forward to receiving your application. If you have any questions about the awards, please email vishanti.fox@iop.org.

Tribute

Brenda Jennison: physicist, teacher and trainer

Former IOP Head of Education, Catherine Wilson, offers some personal reflections on her friend who passed away in March.

Brenda Jennison's reach and influence were enormous and she was one of the most remarkable women that I have ever met. Whenever she engaged with a project, an initiative or an organisation, she did so wholeheartedly, giving generously of her time and her talents.

The space afforded does not allow me to list all of Brenda's achievements – her support for the Institute of Physics, her contributions to the Practical Physics website, her establishing the annual Physics at Work event, her championing of girls in physics and her international links, especially with the physics education community in Japan. She served on various IOP education-related committees and on Council, and in 1996 she was awarded the Institute's Bragg Medal for her outstanding service to physics education.

After training in Cambridge in the 1960s, Brenda went to teach at a London grammar school, one of 50 schools trying out the new Nuffield materials. She commented that the pleasure of teaching these girls left her breathless, many of them being brighter than herself.

By kind permission of the Master and Fellows of Churchill College, Cambridge

Brenda Jennison MBE (1941–2017).

Brenda really enjoyed teaching, especially her involvement with the Nuffield trial, and because she enjoyed it she hadn't really intended to leave. However, she had already demonstrated her skills as a teacher of other teachers on Nuffield in-service training courses and her head of science, without her knowledge, sent off for an application form for the post of training physics teachers at Cambridge.

Brenda applied and was appointed in 1970, becoming the only female physics teacher trainer in the UK at that time. In the more than 30 years that followed, Brenda trained nearly 350 physics teachers. Think of the very best teachers of physics in England and Wales and I will bet you that the vast majority of them were trained by Brenda.

Asked once by a student what were the characteristics of a really good physics teacher, Brenda replied:

- a love of physics and wanting to learn more;
- enthusiasm to hold a conversation with students about physics;
- a willingness to get involved beyond the school walls, to bring in ideas to keep your teaching alive and lively; and
- being self-motivated and enjoying your teaching.

Brenda exemplified all these qualities, and more, in her own classroom teaching and in her training of future teachers.

For more information: this is an edited version of a blogpost at iopblog.org/a-tribute-to-brenda-jennison-physicist-teacher-and-trainer/.

Scotland

A new celebration of physics

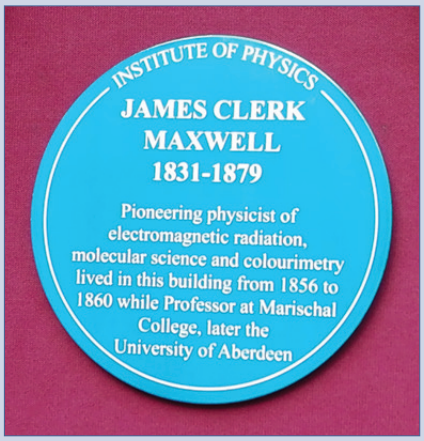
The inaugural IOP Scotland Festival of Physics will take place on 4 and 5 November at George Watson's College in Edinburgh.

This two-day celebration of the role of physics in our lives will emphasise the intersections of science and other forms of culture, and celebrate the roles of Scottish physicists in the inventions and discoveries that have shaped our world.

The programme will be family- and teen-oriented during the day, with events for adults taking place during the evenings. There will be hands-on activities, performances, talks, debates and exhibitions.

There is also an open call for proposals to inspire a new generation of curious minds. The IOP will provide support and guidance for the development of this content and offer free training in science communication for members wishing to develop their public-engagement skills.

For more information: or to get involved, contact Siân Hickson, Public Engagement Manager for Scotland, on sian.hickson@iop.org.



Dr Francisco J Perez Reche, University of Aberdeen

This IOP-sponsored blue plaque was unveiled in March by Astronomer Royal for Scotland, Professor John Brown. It honours James Clerk Maxwell, the great physicist who formulated the classical theory of electromagnetic radiation. He became Professor of Physics at Aberdeen University's Marischal College at the age of 25. The plaque is located outside the 129–131 Union Street building in which Maxwell lived.

Wales

Lab in a Lorry goes back out on the road

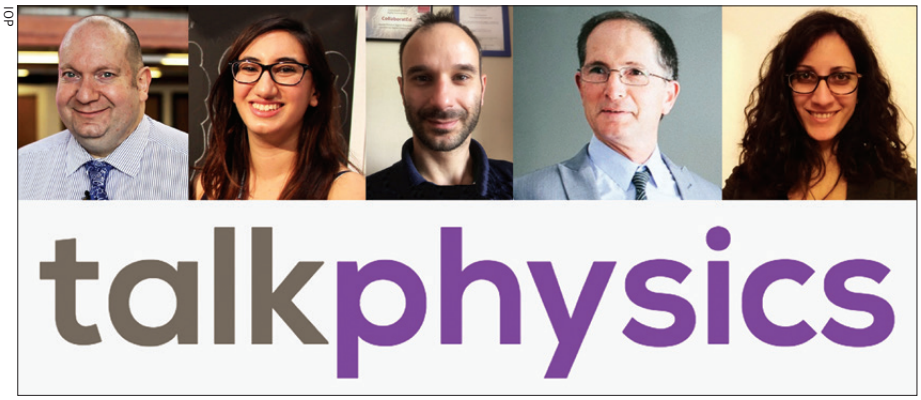
Our mobile schools lab has received funding to continue touring Wales until March 2018. There is already a waiting list of schools wanting us to visit, but please do go to our website to request a visit and get on the list. All you need is somewhere big enough to park the lorry and a group of enthusiastic 11–14 year olds!

Priority is given to those schools that we have not visited before, but we are starting to make return visits too. We are always looking for volunteers to help staff the lorry too. Lab in a Lorry is supported by the National Science Academy.

For more information: our website is labinalorry.org.uk.

Online teacher community

Talking Physics launched



The TalkPhysics team (from left to right): Dave, Andrea, Alessio, Ian and Luisa.

We have made some changes to TalkPhysics.org that we wanted to share.

The most exciting – and often asked for by users – is the launch of a public group: *Talking Physics*. Posts to *Talking Physics* can be viewed outside the login, with the user's profile details anonymised. The rest of your conversations remain securely behind a login screen – which means they can't be accessed by anyone who isn't a member of the site.

You can also access TalkPhysics' events booking (talkphysics.org/events) without logging in.

This is also a good opportunity to introduce the TalkPhysics team. Dave Cotton, Ian Lawrence and Alessio Bernardelli are TalkPhysics' editors/moderators. They are all teacher trainers with many years' experience in the classroom and they support the community by promoting discussions and responding to teachers' questions. Andrea Rialas is the new community manager for the website and Luisa Bellieni manages the approvals systems for the site, including member registrations and event bookings.

So if you have a burning physics teaching question and want to ask it in a safe, friendly, knowledgeable environment, then TalkPhysics is the place to go – it's your online community.

Visit the new Talking Physics group at: talkphysics.org/groups/talking-physics. No login or registration needed. To contact the TalkPhysics team with feedback and comments, email talkphysics@iop.org.

Gender balance

PISA: the UK, science and gender

The UK has been ranked 38 out of 48 countries in the first PISA (Programme for International Students Assessment) wellbeing report, published in April. UK school students have a lower than average life satisfaction, a lower sense of belonging and higher schoolwork-related anxiety, with girls more likely to report a low satisfaction with life.

But it's not all bad news. The data also shows that learning science has become more enjoyable in the UK: in 2015 about 10% more students enjoyed learning science compared with in 2006, making the UK the country with the fourth greatest increase, although this improvement was greater for boys than girls.

The UK has a smaller than average performance gap for science between girls and boys. And the number of students expecting to work in science-related occupations has increased from 18% in 2006 to 29% in 2015 – the UK is the country with the second-highest increase. However, the choice of occupation remains highly gendered, with 17% of boys and 8% of girls seeing their future selves as engineers; 20% of girls and 7% of boys seeing themselves as health professionals.

"There is still much work to be done in countering the gender stereotypes that limit student aspiration," says Jessica Rowson, IOP Gender Balance Manager, pre-19. "Girls may opt out of physics if these stereotypes are not challenged."

PISA is an international survey of countries' educational systems, run by the Organisation for Economic Co-operation and Development.

For more information: visit oecd.org/pisa.

STIMULATING PHYSICS NETWORK

South York Day for Everyone Teaching Physics

Tapton School, S10 5RG

27 June

A free event designed to inspire your teaching, upgrade and develop your pratical physics skills, and present new ideas and suggestions to incorporate into your teaching. For more information and registration: bit.ly/SouthYork.

Taking the fear out of physics

Last year, new teacher Daf Keyse attended the York SPN Summer School.

"My first few years were spent teaching biology, chemistry and applied science with a handful of physics modules. Then the school asked me to write a plan to reintroduce A-level physics for the next academic year.

"Fortunately, my head of science had worked with SPN previously and recommended that I join one of the chemists on the York Summer School.

"The course brought out the giant kids in my colleagues and myself. It's really great fun, you learn a great deal and are given loads of low cost or free ideas that you can try in your own classroom.

"There are sessions on specific areas of physics – energy transfers, momentum, light and even radiation – led by the highly knowledgeable but also extremely approachable TLCs, and you're more than encouraged to take part in all the practical activities. Ways of modelling the more challenging components are provided, as well as ensuring that the less challenging areas are secured.

"After you've had your brain filled with a day full of physics, there's a quiz in one of the local pubs or a tour of York with a big dinner on the last night. It's also a great networking event – I stay in touch with teachers across England and we share ideas whenever we need to."

Read Daf's full blog at: bit.ly/SPNyork.

Book for 2017 at York at: stimulatingphysics.org/summer-schools.

Community

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

Professional development

Teaching Science helps you find good CPD

The UK's leading scientific institutions have got together to produce a new resource to help secondary-school science teachers find CPD opportunities. The tools are suitable for everyone, from newly qualified teachers to heads of department.

The Teaching Science website will help you identify areas for development, find tailored and effective support, and track your progress to improve learning for all students.

As a registered member you can find tailored support for your continuing professional development by using the self-review tool and track your progress over time.

Pick the guidance in the format that works best for you, filtered by subject, age group and career stage:

Teaching Science

- **Resources** – journals, contemporary research and leaflets
- **Face-to-face** – conferences, workshops and courses
- **CPD online** – online resources and downloadable materials
- **Networking online** – discussion groups and forums
- **Networking face-to-face** – local workshops and events

For further information: the website can be found at www.teachingscience.co.uk. It is a collaboration between the IOP, the Royal Society of Chemistry, the Royal Society of Biology, the Association for Science Education, STEM Learning and the Wellcome Trust.

Resources

Sharing suitable physics teaching resources

Resource-sharing websites have long been a life-saver for teachers across the world, but finding suitable online resources is not always as easy as it seems.

Physics teacher Sally Weatherly (who is also an IOP Physics Network Co-ordinator in her spare time) points out that an online search for "Boyle's law worksheet" produces around 50,000 results.

"Most of the worksheets clicked on were unsuitable," she explained. "The physics was wrong, questions were written incorrectly and the documents were in the wrong format to allow adaptation. One could easily while away an hour looking for the right worksheet, which defeats the purpose of resource sharing."

So Sally decided to set up a free resource-sharing website, Guzled, aimed at simplifying searching for good-quality reliable resources suitable for UK teachers, by sidestepping the mountain of resources some sharing sites now host.

The Guzled community is a bank of resources for GCSE and IB/A-level physics, and also has a blog on current physics teaching issues. The site does also host paid-for content, but Sally is adamant that the Guzled community resources will remain free.

To access/share resources: register at guzled.com.

School researchers

Junior journal offers £500 award prize

A new, online academic journal for school-age researchers has created an award to celebrate its launch.

The *neonEidos* journal publishes research from all disciplines. The neonEidos Award has two entry types. The Feature Article offers a first prize of £500 for the lead author and £500 for the school to fund research equipment or travel grants for research. The Discussion Article first prize awards the author £250.

The journal is aimed at academically ambitious young people, providing a place to publish their work and to start building a research portfolio. It is managed by a team of editors from the Royal Society of Edinburgh's Young Academy of Scotland. A team of reviewers delivers real-world academic feedback to researchers.

neonEidos also functions as a journal-of-record, hoping to incentivise teachers and schools to invest in the most demanding activities.

For more information: visit neoneidos.com. Articles should be submitted by 31 August.

Pedagogy

Conference debates what is a serious STEM question?

Ian Galloway, former chair of ASE, PGCE tutor and IOP Teaching and Learning Coach reports on the T³ (Teachers Teaching with Technology) Conference, *Igniting Serious STEM education.*

"In March about 100 teachers and 25 education officials came together in Brussels. My group focused on what teachers might expect when they search a database for questions tagged as STEM. Everybody brought questions and these were studied in small groups using Eric Rogers' process known as question shredding.

"Both mathematics and science teachers were in the group, and we astounded each other by the different style and content of what we thought was a good STEM question! Virtually all our questions were shredded.

"We are beginning to populate t3europe.eu with what we feel are good STEM questions and will continue to develop our ideas."

For more information: T³ is a world-wide network of teachers, sponsored by Texas Instruments. Contact Ian at Copernicus@physics.org.

Marvin and Milo

Bee swinger

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.

What you need

- An ice-lolly stick
- Blu-Tack
- String
- A thick rubber band
- Sticky tape
- Thin card
- Scissors

Instructions

1. Put a blob of Blu-Tack at both ends of the lolly stick.
2. Cut a piece of thin card so it fits between the blobs, then tape it to the stick.
3. Tie a piece of string securely next to one of the blobs of Blu-Tack.
4. Stretch the rubber band around the stick.
5. Find a clear space and swing your bee swinger about your head.
6. Try cutting the card into different shapes – can you hear a difference?

Results and explanation

As the bee swinger moves through the air, the rubber band starts to vibrate. The card amplifies the sound so that you can hear it.

IOP Affiliated Schools will receive our new Marvin and Milo Sound Activity Cards with the next issue of *Classroom Physics*.

New from beyond the IOP

Sport and Sustainability

Sir Ben Ainslie's Land Rover BAR team hopes to win the America's cup for the UK for the first time in 166 years. The team's charity has partnered with the **Institution of Engineering & Technology** to launch free films, worksheets and interactive quizzes aimed at 11–16 year olds. The resources showcase the technology behind the Land Rover BAR's catamaran sustainability. Register at bit.ly/BT-STEM-Crew.

Particle Accelerators for Humanity

Many students have heard of particle accelerators following the discovery of the Higgs boson at CERN. But do they know there are tens of thousands of accelerators around the globe? The **Royal Institution** has released a series of short films showcasing the science behind accelerators and their wide-ranging uses, from cancer treatment to probing the taste of chocolate. Available on YouTube at bit.ly/RIaccelerator.

The Expansion and Age of the Universe

Cardiff University has developed educational materials enabling school students to calculate the age of the Universe and how quickly it is expanding via the Faulkes Telescope network. The resources use observations of supernovae taken using the telescopes and use Hubble's law. Resources plus teacher guides, student worksheets, background information and quizzes can be found at bit.ly/Faulkes or email BartlettS2@cardiff.ac.uk.

Photonics 4 All

Southampton University's Physics and Astronomy group has just completed a project to highlight photonics. Their hands-on activities are aimed at teaching years 8 and 9 about light theory and applications of light and laser technology. The resources include a best-practice handbook, quizzes, crosswords, an app, plus teachers' workshops and a Photonics Explorer Kit at photonics4all.eu.

Space Explorers Video Games

The **University of Westminster** matched six planetary/space scientists with six cult indie games (eg *Call of Duty*) based on the science of the robotic exploration of Mars and human spaceflight. By highlighting the research and career of the scientist guest, the team hopes to encourage youngsters to study STEM subjects. The scientists discuss their adventures on YouTube videos at bit.ly/Spacegames.

Lego Nuclear Physics

The Binding Blocks program uses Lego to introduce nuclear physics topics for secondary schools – from fusion and fission to nuclear physics in medicine and exotic nuclei. The project involves building a three-dimensional nuclear chart of all known nuclear isotopes out of more than 28,000 pieces of Lego.
The **York University** team are now producing teaching materials aimed at A-level students. Find out more at york.ac.uk/physics/bindingblocks.

talkphysics

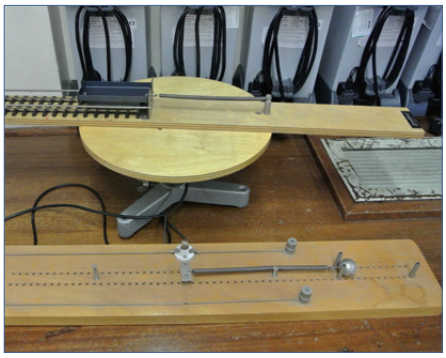
Our online discussion forum for teachers of physics, technicians and teacher supporters.
Log in or register to join these discussions at talkphysics.org.

Mysterious equipment: what are these?

All schools have cupboards sheltering pieces of kit that noone can identify. Matthew suspected he had circular motion apparatus but it was dusty and the electrical components didn't work. He admitted, "I have no idea what the board in front is for with the lightbulb." The group pieced together the answer, even finding an instruction sheet for the demo on the IOP's TAP resource. Matthew's students loved it!

- Posted in the *Mysterious Equipment* group at bit.ly/TPmystery.

Matthew Lewis



Need some help – maths for physics

"I am sure you all have the experience of getting a new group of A-level students and realised they can't rearrange an equation etc, and thought I had better teach them maths first. I decided that I would plan this into the syllabus for the next year, but wondered if anyone had developed such a scheme before I set off and try myself?" This popular thread is useful for teachers of all levels.

- Posted in the *Talking Physics* group at bit.ly/TPmaths.

Ways to boost your ripple tank

Claire, a new head of science and new to TalkPhysics, was trying to get up to speed with the physics lab equipment. "I have a ripple tank and it seems to be rather unused. Can someone tell me if the ripples you can see are the best I can get out of it? Also, what can I do with it (or suggest teachers in my department do with it) to enthuse students? They seemed really underwhelmed and I suppose this could be because I am not getting the best out of it. Any comments or help will be greatly appreciated!" TalkPhysics members waded in with a sea of great suggestions from adding food dye or ink to the water to increasing the size of the ripples by using Blu-Tack to make the motor lop-sided, plus a video showing how the ripples should look.

- Posted in the *News & Comments* group at bit.ly/TPripple.

Our YouTube channel hosts videos from our events and lectures, interviews, physics demos and more.
Subscribe at youtube.com/user/InstituteofPhysics.

Physics and ballet combine

This video is based on a joint IOP–Royal Opera House event that explored how knowledge of the biomechanics of dance can reduce the risk of injury and help ballet dancers to enhance their performance. It will show your students a surprising application of physics: by simultaneously capturing ballet steps through motion-sensor tracking and displaying on a screen, physicists can uncover the relationship between gravity and grace. This technique has, for example, revealed that the force bearing down through a dancer's ankles can be up to 14 times their own body weight.

- Watch at bit.ly/IOPytballet.

IOP

Why teach physics?

These short videos from new and experienced teachers capture some highlights of teaching physics. They have been designed to promote careers in physics teaching as part of the IOP's continued campaign to tackle physics teacher shortages. If you're recruiting prospective teachers, share the videos via email or your social media channels to demonstrate how rewarding teaching can be. And don't forget to mention the £30,000 IOP Teacher Training Scholarships (iop.org/scholarships). To get involved in our campaign, email teach@iop.org.

- Watch at bit.ly/IOPytteach.

Early career teacher classroom tips

We've been working with former IOP teaching and learning coach Rozanna Poole to create a series of videos that address some of the distinctive challenges that early career teachers face in the physics classroom.

The first three videos are now available on the IOP Early Career Teacher webpage. They guide new teachers through barriers to learning such as student preconceptions of physics and the unfamiliar language of physics. They also look at the effects of trying to pack too much into lessons, from both the student point of view of whether they are learning and the teacher point of view of whether managing five practicals a day is sustainable.

Further videos are planned including:

- behaviour management in physics lessons
- physical considerations when teaching physics
- how to recover from an unsuccessful lesson
- how to take the pain out of lesson planning
- managing demonstrations and practical sessions in the lab.
- Watch at bit.ly/IOPytect.

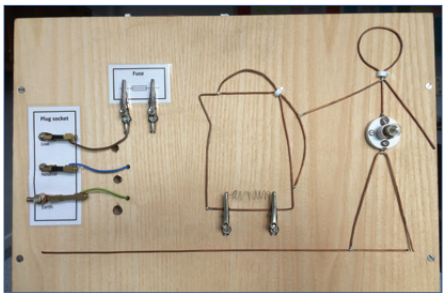
Physicseducation

To view these papers online, use your IOP number for your login. Your password is the surname of the named IOP affiliate contact for your school. If you don't have these details, email affiliation@iop.org for a reminder.

Earth connections and fuses

The Electrocuted Man or Woman goes back almost 50 years, but it is a great way to demonstrate how the earth connection and fuses work together to protect us from faulty appliances. The subject can be quite abstract and difficult for pupils to grasp, but this simple and visually clear demonstration is easy for most physics departments to build and can make the concepts much more immediately understandable.

- By Mark Harrison (King Edward's School, Bath) in the March 2017 issue: bit.ly/PEDelectrocute.



Physics Education

Ball-pool Higgs model

The Higgs boson was discovered in 2012 at CERN. It caused great excitement amongst the general public, and just over a year later British physicist Peter Higgs was awarded the Nobel Prize in Physics. There have been several attempts to elucidate the physics and importance of the discovery (CERN even released a Higgs pizza recipe bit.ly/CERNpizza). This *Physics Education* paper describes a model that uses a children's ball pool to represent a universe filled with a certain amount of the Higgs field. Have fun!

- By Giovanni Organtini (Sapienza University of Rome) in the March 2017 issue: bit.ly/PEDhiggs.

What actually is an image?

One of the highlights of teaching physics is when a student asks an apparently simple question and you realise the limits to your understanding, such as "What is an image?" Students meet the concept of an image early on, for example when using pinhole cameras or finding the position of an image in a mirror. They already know the term in photography and design, and through image-manipulation software. But what is meant by the term "image"? The author of this paper felt that definitions such as "a representation of an object" or "a reproduction of an object formed using a mirror or lens" are not clear enough. This paper will make you think about something you thought you already knew – you could end up changing the way you teach optics after reading it.

- By Ken Zetie (St Paul's School, London) in the March 2017 issue: bit.ly/PEDimage.

physicsworld

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Cuckoo forgeries: a bird's-eye view

Cuckoos are known for their devious ways, laying and leaving their eggs in the nests of unsuspecting hosts. This article highlights the unfortunate plight of the dunnock who, despite laying pale-blue eggs in comparison to the cuckoo's cream eggs, seems unable to differentiate between the two, a difference that is so apparent to us. The author examines whether physics and computer models can help researchers visualise why it is that sometimes the imposter is spotted and other times overlooked.

Frans Lanting, Mint Images/Science Photo Library

- By Liz Kalaugher in the January 2017 issue: bit.ly/PWcuckoo.

Smarter machines look to emulate the brain

The brain runs on approximately 20 watts of power – less than a light bulb – and yet at this power the human brain is able to do things that supercomputers still struggle with, such as advanced pattern recognition. This article explores how a new generation of computational devices are being developed to mimic the network of neurons inside our heads, with the ultimate aim of emulating the unique talents of the brain.

- By Jessamyn Fairfield in the March 2017 issue: bit.ly/PWbrain.

Deducing how dinosaurs really moved

How did dinosaurs dash and their cousins the pterosaurs take flight? Could a *Tyrannosaurus rex* outrun a jeep? Could a *Stegosaurus*'s fearsome spike-laden tail be used as a weapon? How did the giant *Quetzalcoaltus*, which stood as tall as a giraffe, with a wingspan of 11 m, a head of 3 m long and a body of about 75 cm long, stay airborne? While some bones and muscle fragments have survived the last 65 million years, no flesh has been preserved. So despite the questions arising from palaeontology, the answers lie in physics, force diagrams and multi-body stimulations. This article explores how physics-based modelling is helping to solve these mysteries of movement, flight and defensive techniques. It also finally answers one of the biggest scientific questions posed by *Jurassic Park*: could a *Tyrannosaurus rex* outrun a jeep?

- By Matthew R Francis in the February 2017 issue: bit.ly/PWdinos.

EVENTS FOR TEACHERS

Electromagnetism with Confidence
Brooke Weston Teaching School, NN18 8LA
21 June
This workshop is designed for science teachers, particularly non-physicists and/or new teachers who are being asked to teach physics GCSE topics and the technicians who are asked to support this practical work. For more information and registration: bit.ly/electroconfidence.

Space as a Context for Teaching Science – the James Webb Space Telescope
Rutherford Appleton Laboratory, Didcot
21 June
Enrich your classroom teaching by using space and the upcoming launch of the James Webb Space Telescope (JWST) as an inspiring context for learning STEM subjects. For more information and registration: bit.ly/JWspacetelescope.

IOP Physics Big Day out at Cosford
RAF Cosford Museum, Cosford
22 June
A full day of free physics CPD from the SPN team and the IOP Teacher Network. Join us for a variety of sessions, hands-on workshops and a guest lecture from Dr Jess Wade, Imperial College London. For more information and registration: bit.ly/Cosford.

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. For more information and booking: 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 is free to participants. For more information and registration: bit.ly/DurhamTeacher.

Physics and Chemistry Subject Booster Course – Week 1
Charterhouse School, GU7 2DX
3–7 July
This free week-long residential course is aimed at boosting physics and chemistry subject knowledge. For more information and registration: science@charterhouse.org.uk.

Find a local CPD event at talkphysics.org/events.

KS4 Talking Energy
Bolton School Girls' Division, BL1 4PB
4 July
This workshop will focus on developing good practice for the teaching and learning of energy topics in KS4. For more information and registration: bit.ly/KS4Talking.

The 10th IOP Conference
Bangor University, LL57 2DG
4 July
A teacher conference for all who teach physics in North Wales. The day will include a keynote lecture "Bionic boy" from Ben Ryan, founder and CEO of Ambionic, as well as a selection of workshops. For more information and registration: andrea.fesmer@talk21.com.

Teach Physics with Confidence
Sir Christopher Hatton Academy, NN8 4RP
6 July
A day of free physics CPD for non-specialist teachers teaching physics at KS3 and KS4. The day will include a range of practical strategies and demos focusing on motion, covering topics including speed, velocity and acceleration. For more information and registration: bit.ly/motionconfidence.

APPEAL-8 – Misadventures Along the Path to Big Physics Discoveries
Department of Physics, University of Oxford
8 July
The University of Oxford in collaboration with CERN is running a one-day school to give A-level teachers an opportunity to learn about the phenomena and scientific challenges that connect astrophysics, particle physics and the physics of particle accelerators. For more information and registration: bit.ly/Appeal8.

Annual Physics CPD Conference
Charterhouse School, GU7 2DX
8 July
A full day of physics CPD workshops provided by the SPN, including a wide range of workshops, supplier exhibitions and a chance to network with colleagues from across the region. Keynote speech by Anu Ojha OBE, director of the UK's National Space Academy Programme and a director of the National Space Centre. For more information and registration: bit.ly/annualSPN.

Micro:bit in Space
National STEM Learning Centre, York
18 September
Learn how to use this sensor-equipped and easy-to-program device to improve understanding in science and computing within the context of space. The activities covered will link to the science and computing curriculums, and are designed to help challenge children to demonstrate their understanding in novel and stimulating ways. For more information and booking: bit.ly/MicroSpace.

East Midlands Network Day
Ockbrook School, DE72 3RJ
23 September
An event for all involved in the teaching of physics .The day will include a keynote speaker and a choice of three workshops from seven on offer. For more information and booking: nealgupta@me.com.

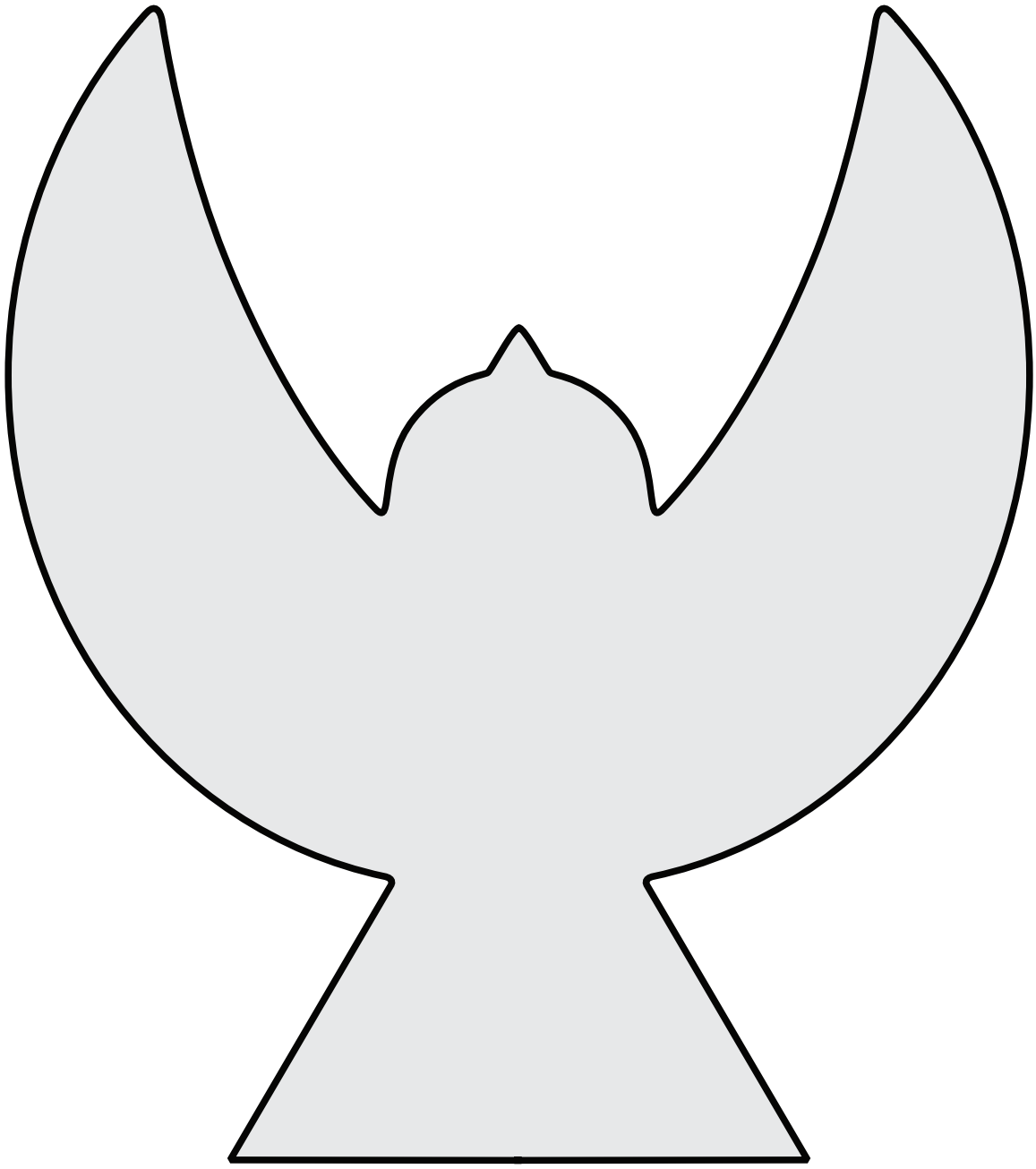
Back to Basics Astronomy Workshop
West Norfolk Professional Development Centre, PE30 2HU
7 October
The British Astronomical Association has designed a programme of talks and practical sessions to help you learn basic techniques and develop your interest to its full potential. For more information and registration: bit.ly/BritAstro.

EVENTS FOR STUDENTS

Year 10 and Year 12 Careers Conferences
National Space Centre, Leicester
22 June and 5 July (Year 10) and 1 and 20 November (Year 12)
The Careers Conferences aim to raise the profile of the space sector to show the diversity of careers, both academic and vocational, available within the sector. For more information and registration: bit.ly/CareersCon.

Nuffield Research Placements
Nationwide
Nuffield Research Placements (previously Nuffield Science Bursaries) provide more than 1,000 students each year with the opportunity to work alongside professional scientists, technologists, engineers and mathematicians. Applications open on 24 October 2017. For more information: bit.ly/Nuffield2017.

Balancing bird



Instructions

1. Carefully cut out the bird.
2. Can you balance the bird on the tip of your finger?
3. Using the Blu-Tack, stick one penny underneath the tip of each wing.
   Try to balance the bird using its beak.
4. If it doesn't work, try repositioning your pennies.

Teachers: please copy the above bird template onto card. See page 12 for additional information.

Balancing act: tricks and tips to illustrate moments

1. The box demonstration

Equipment required:

- Large cardboard box (eg 1 m × 1 m × 0.5 m)
- Brick (or other 2 kg mass)
- Helium balloon

Procedure

Before the lesson, place the brick inside the box along one of the shorter ends. Set up on the front bench so that as much of the box as possible overhangs the bench while still remaining balanced. At the other short end of the box (furthest away from the bench) attach a helium-filled balloon (figure 1a).

As students arrive in the classroom they will notice a big cardboard box balanced by a small edge on the front bench that appears to be balanced by the balloon. The whole set-up seems counter-intuitive.

Ask students to offer explanations. Cut the string to the balloon to demonstrate that it is a red herring.

After revealing how the trick works ask students to draw force diagrams and/or identify clockwise and anticlockwise moments (see figure 1b).

2. The bird activity

Equipment required per student:

- Bird template (see page 11) photocopied onto card
- Scissors
- Two pennies
- Blu-Tack

Procedure

Explain that the students will be making a balancing bird (figure 2a) and then ask them to follow the instructions on the worksheet.

After the students have built their balancing bird, draw force diagrams and/or identify clockwise and anticlockwise moments (see figure 2b).

For more information about moments: visit Supporting Physics Teaching at bit.ly/SPTmoments (14–16s) or Teaching Advanced Physics at bit.ly/TAPmoments (post-16). More moments activities on Practical Physics at practicalphysics.org/balancing-beam.

Carol Davenport is the Vice-President of Education at the Institute.

Figure 1a. The box with and without balloon attached.

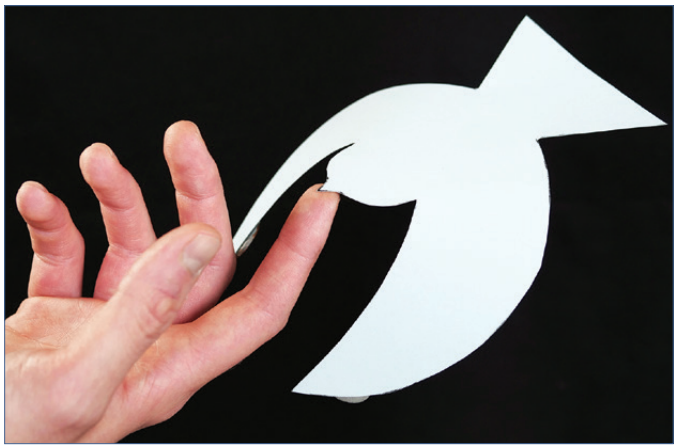


Figure 2a. The completed balancing bird.

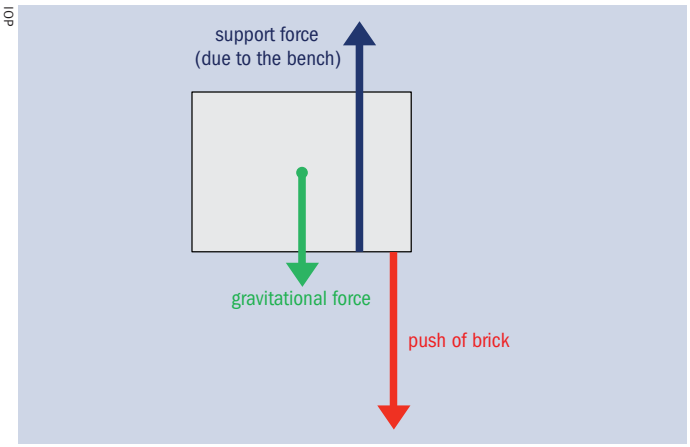


Figure 1b. The forces and their positions for the box at its tipping point.

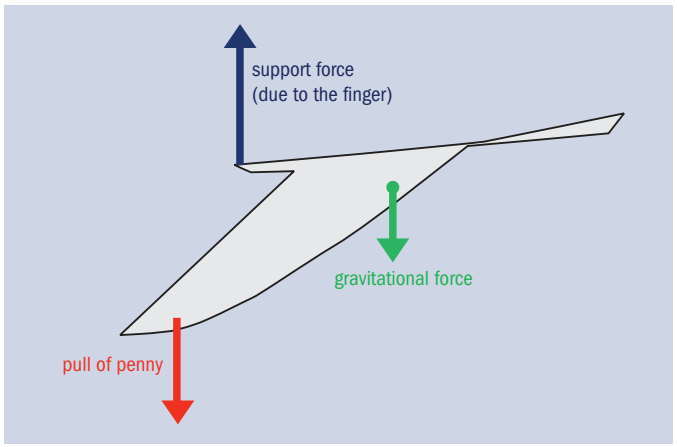


Figure 2b. The forces acting on the card for the balancing bird.