

Classroomphysics

The newsletter for affiliated schools June 2015 Issue 33

Careers

Help students visualise future in VFX

Affiliated schools and colleges will have received with this newsletter the latest report in our *Physics Works* series, *VFX*. The film education charity Into Film has also produced a careers poster, *Careers in Visual Effects*. Both resources highlight careers in one of the fastest growing creative industries in the UK: visual effects (VFX). It is another example of the many options for which physics and the subject of physics are a good preparation.

Physics in VFX

Students may not realise just how important physics is to VFX. To start a discussion, show a film clip from one of the productions featured in *Physics Works: VFX*. More than 4000 film titles are available via the education charity Into Film, simply sign-up to their film club programme (available free to all state-funded schools and colleges).

Once a film clip has been decided upon, play it to the class and ask your students to identify which areas of physics the VFX artist needs to understand to produce a particular effect.

Alternatively, show a behind-the-scenes clip of how VFX are produced in films such as *Snow White and the Huntsman* or *Gravity* (see Useful resources).

Routes into VFX

Historically, entry into VFX was informal, usually through the runner route (see *Careers in Visual Effects* for details). However, the industry is changing and most entrants now study a course offered by a private vocational training provider or a university.

- If a student decides to pursue a career in VFX via an effects-related course, they



Image courtesy of Framestore. Copyright Warner Bros.

Films such as *Gravity* can provide opportunities to discuss the use of physics in VFX.

should choose one that is backed by industry through Creative Skillset's Pick the Tick scheme (Creative Skillset is the sector skills council for the creative industries).

- If they choose to go down the physics, maths or engineering degree route, they can then either get further training at a VFX company or specialise through a Creative Skillset accredited master's degree.

Once a student has completed their studies they can then choose between becoming a specialist working in one of the larger VFX companies in London, or becoming a generalist in smaller production houses in cities such as Manchester, Bristol, Cardiff, Glasgow and Belfast.

They can also choose between specialising in TV (working on short projects that typically last a few weeks at a time), or in film (which involves more challenging projects lasting a few months). Whichever career path they choose, remind them that continuing with physics post-16 is an important first step.

INTO FILM

For more information:

on the UK's VFX industry, visit www.creativeskillset.org/vfx

and explore industry-accredited courses at www.courses.creativeskillset.org.

Useful resources

- Find out about how the VFX in the film *Interstellar* have led to new insights into the physics of black holes at www.dneg.com/blackhole.
- View behind-the-scenes VFX footage from *Snow White and the Huntsman* at www.milk-vfx.com/snow-white-and-the-huntsman or *Gravity* at www.framestore.com/gravity
- Download a digital copy of *Physics Works: VFX* via www.iop.org/publications/iop
- Download a digital copy of *Careers in Visual Effects* via bit.ly/1DqDGTq
- Set up a film club for access to thousands of films and resources via www.intofilm.org/schools-film-clubs

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

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Editorial



Welcome to the last edition of *Classroom Physics* for this school year. Many of you will be emerging from the challenges of the summer term and will be eagerly looking ahead to the renewal that comes with summer.

Our front-page story illustrates the importance of physics to the visual effects industry and provides clear guidance on what it takes to break into the field – an interesting context for a lesson or careers discussion with your students. Affiliated schools and colleges will have received the *Physics Works: VFX* booklet and the *Into Film* poster, for further accompanying information.

This newsletter highlights two opportunities to get involved with the Institute's work. Firstly, if you would like to earn £100 and can give an insight into those exciting and challenging first years in the classroom with an article on "The first time I taught...", please get in touch (details on page 3). Secondly, all affiliated schools and colleges are invited to the next Education Forum meeting, held on 11 July at the IOP in London. This meeting is a chance to influence our education projects and policy work (page 2).

For those of you looking ahead to the new school year, we have provided a comprehensive summary of the changes to A-level practical work (page 3). Affiliated schools and colleges will also have received a copy of the booklet *Light and Matter*, which will provide useful inspiration for lessons linking into the International Year of Light.

We would like to extend considerable thanks to Clare Thomson for her wonderful work as editor and founder of this newsletter. Since issue 1 she has worked tirelessly to bring you the latest in physics education news and we wish her all the best for her retirement. Eloise Kohler has joined the team as assistant editor. As ever, your comments or suggestions are most welcome via our contact details below.

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Teacher event

Programme for IOP Scholars gets meteoric lift-off



An IOP Scholar holds a comet made of water, sand, graphite, alcohol, Worcestershire sauce and dry ice.

Our new programme for IOP Scholars launched in January, with a visit to the National Space Centre in Leicester. This was the first of six events tailored to the needs of trainee specialist physics teachers. Spread across England, they aim to develop pedagogy and fuel the scholars' love of their subject while also providing a valuable opportunity to build peer support networks and have a great day out.

The programme has two strands. The first is a set of Supertrips, which are outings to physics venues that the scholars may visit with future cohorts of pupils. We organise a taster of the venue's education resources, then a member of our teacher support team (a Physics Network Coordinator or Teaching

and Learning Coach) runs a session on planning school trips, relating it back to the classroom and curriculum.

The second strand is a series of Masterclasses, which are small workshops run by expert teachers on particular topics. They are designed to be challenging and inspire the new teachers by introducing physics teaching ideas beyond the basics.

This year, we have 150 IOP ITT Scholars. Other Supertrips have been organised to Jodrell Bank and Woolsthorpe Manor, along with Masterclasses on data-logging, resource-writing and particle detectors.

For more information: visit www.iop.org/scholars

Policy

Invitation to Education Forum meeting

Physics teachers from all over the UK and Ireland attended our latest Education Forum meeting held in February to discuss issues around the assessment of practical work, modelling and the future of the physics teaching profession.

The main contact at each affiliated school and college is now invited to attend the next meeting, which has been scheduled for Saturday 11 July at the IOP in London, from 10 a.m. until 4 p.m. Lunch and refreshments will be provided and reasonable travel expenses can be reimbursed.

These meetings are opportunities for

the IOP to seek the teaching community's opinions on changes to the physics curriculum and qualifications landscape. The programme for the next meeting will include a workshop on comparing the various awarding organisations' support material for the new approach to assessing practical work in A-levels.

For more information: visit iop.org/educationforum and to reserve your place at the meeting contact Manchi Chung (manchi.chung@iop.org) with your name, affiliation and any dietary/access requirements.

Practical work

A-level changes affect practical assessments

A-level physics will be different from this September. The most notable changes are to the ways in which practical work will be assessed and reported. And, thus, the ways in which it is employed during the course.

There are two components to the assessment of practical work:

- Questions in the written exams: these will count towards the final grade and provide the only differentiation on practical work; they will be designed to give an advantage to students who have had a thorough exposure to practical activities during the course.
- An endorsement of laboratory techniques: this will be reported separately from the main grade (as a pass/fail). The requirement is that students complete at least 12 practical tasks over the two years. The tasks have to cover a range of skills that have been specified by Ofqual; teachers will have to ensure (and confirm) that students have mastered those skills.

Both of these approaches are new and it remains to be seen whether they are successful in developing the desired fluency with practical techniques and procedural knowledge. However, it is certainly the case that there is more flexibility. And these changes may even represent an opportunity to change the emphasis of practical work by moving practical sessions away from assessment and towards educational benefit. In some schemes, it may be possible for you to make the assessment almost invisible. Even the word “assess” may be too strong for what is required in the laboratory (although there is still some discussion about how rigorous the teacher observations need to be).

We hope that it should be possible for teachers to develop a sequence of activities that genuinely support the development of practical skills. At a convenient point in that sequence, they can observe the students to confirm that they have acquired those skills.



City of London academy students develop their understanding of science through practical work.

Depending on your choice of exam board, you can choose the tasks that you use, when you use them and when you make observations that count towards the practical endorsement. So, for example, one of the required techniques is to be able to “design, construct and check circuits using DC power supplies, cells, and a range of circuit components”. Rather than throwing students into a laboratory-based controlled assessment (at a time determined by the exam system), you will now be able to develop their competence at setting up simple circuits with a number of practical tasks. When the time is right, you can observe the students to satisfy yourself that they have mastered the required techniques. Or, at least, that is how we hope it will work.

The awarding organisations are providing guidance and, in most cases, a pack of teacher and student notes for 12 activities.

However, you should not feel restricted to that small set. And no-one wants to see the pack being used as a kind of assessment pack – comprising 12 mini ISAs with vast matrices of check lists. There are plenty of additional activities from a multitude of sources that will support the development of the required skills and some of them can even be used to “assess” those skills. For some examples, please try the Institute’s sites: practicalphysics.org and tap.iop.org. And, of course, join discussions on talkphysics.org.

Look out for a follow-on article in September about using logbooks in a constructive way.

For more information: on Ofqual guidelines, visit tinyurl.com/n5a247r, or join an IOP email discussion group to share ideas at tinyurl.com/kk4qzwm.

Teacher blog

The first time I taught...

Physics teaching involves lots of experiments and that is why we love it. But, especially in the early years, it is not just the pupils who are carrying out experiments: teachers are constantly trying to find what does – and what does not – work in the classroom.

Our new series called “The first time I taught...” celebrates this process. Established physics teachers reflect on their first lessons and share how their teaching has developed since. Some experiences

“Trying to illustrate the electrostatic effect using teenagers’ hair is a doomed undertaking. Copious amounts of hairspray and/or styling product (both the boys and the girls) will render any sort of electrostatic charge impossible”

may sound all too familiar, some will inspire you, and others are just hilarious. Whether you are new to teaching, or have been teaching for years, they are a great read.

For more information: visit www.iopblog.org/tag/firsttime or search “first time” at www.talkphysics.org. Have an experience you would like to share? Contact Caroline Davis (caroline.davis@iop.org) with your idea – we pay £100 for published articles.

Resource

Enjoy a great atmosphere with free club

theWeather Club is the public outreach arm of the Royal Meteorological Society, where people can join a community to celebrate, enjoy and talk about the weather.

Full of informative and educational content to make the physics of the atmosphere come alive in the classroom, theWeather Club is free to join. By registering you will gain full access to website content, weather forums and receive a quarterly e-newsletter, bursting with informative features, news articles and images including:

- seasonal weather reviews
- weather and climate research news

theWeather Club



- informative science lessons
- reviews of tools to observe the atmosphere
- expert views of weather and climate phenomena

- travel guides to worldwide destinations
- weather facts and figures.

Free iPad apps accompany each newsletter, which can be downloaded from iTunes.

Dr Liz Bentley, founder of theWeather Club, said: “theWeather Club is for all who appreciate the weather for all its wonders. Its beauty, its power, its fragility, its occasional absurdity, and the deep fundamental influence it has upon us all. It allows us to come together and share our obsession with the weather.”

For more information: and to sign up, visit www.theWeatherClub.org.uk.

Teacher recruitment

Come back! Support for returning teachers

The National College of Teaching and Leadership (NCTL) wants to encourage former qualified teachers of physics to return to the profession and is working with the IOP on a package of support.

If you are in contact with a former physics teacher who is looking to return to the profession, please encourage them to register with NCTL via www.education.gov.uk/returningteachers or 0800 085 0971 to access advice and support including:

- One-to-one support from a dedicated advisor, including access to resources and training/support to build confidence and support with applications and interviews.
- A diverse range of resources from www.iop.org/returningteachers, including access to our school experience programme.

NCTL wants to hear about positive experiences your school has had of employing a returning teacher, how you supported them, and what benefits they brought. If your school has any physics jobs



NCTL and IOP provide support for physics teachers who want to return to the profession.

that returners could apply for, please send information to NCTL about the vacancy, who to contact and how to apply.

If you are a physics teacher who took a career break and have since returned to the profession, NCTL would like to talk to you about your experience.

For more information: visit www.education.gov.uk/returningteachers. Contact NCTL to share your experiences of returning to teaching, employing a returning teacher, or details of any physics vacancies suitable for returning physics teachers, via returntoteaching.NCTL@education.gsi.gov.uk.

Funding

Grants help bring research alive in schools

Partnership Grants of up to £3000 are available to enable students, aged 5 to 18 years-old, to carry out science, technology, engineering or mathematics (STEM) projects in UK schools. The project must be investigative and supported by teachers and STEM professionals (research or industry) working in partnership.

Benefits for students and teachers include:



Pupils from La Sainte Union Catholic School examine leaf miners found in their school's trees.

- better understanding of cutting-edge STEM
- improved perceptions of those working in STEM professions
- pride and ownership from participation in the investigative process.

Application rounds are open twice a year and the next application round is now open.

For more information: on key dates, guidance on how to plan your project and to make an application, visit royalsociety.org/partnership or e-mail education@royalsociety.org.

Invitation

Link up with the Stimulating Physics School Network

A new model for teacher development has launched within the Stimulating Physics Network (SPN) with five schools awarded Link School with Adviser status. They join 30 Link Schools and 400 Partner Schools across England as part of the wider Network.

Prof. Frances Saunders, president of the IOP, said: "We're very excited to be starting this work with schools spread right across England, serving as centres of expertise for neighbouring schools to benefit from."

Each school receives funding from the SPN, and can draw on the IOP's collective experience in supporting, developing and

coaching teachers of physics to provide no-cost CPD for local teachers.

These schools are:

- Skipton Girls' High School in Bradford
- Darrick Wood School in Bromley
- Truro and Penwith College in Cornwall
- St Joseph's College in Staffordshire
- Wildern School in Southampton.

The second round of applications for Link School with Advisor status is now open.

For more information: or to apply for Link School with Advisor status, visit stimulatingphysics.org/link.

Girls in physics

Seven steps to improving gender balance

Partner Schools in our Improving Gender Balance (IGB) and Drayson Projects are trialling new ways to engage girls with physics. Our aim is to improve uptake at physics A-level and beyond.

Teachers from participating schools met recently to share best practice and identify strategies to address gender equity. The outcomes detailed below should be tailored to the needs of each individual school:

1. Audit your school/department or classes in terms of gender balance. Do girls and boys have a similar experience? Where are the differences? Is there a justification for this? Where possible, checking school or department data may be useful, particularly on progression to A-level.
2. If you are looking to redress gender imbalance, make sure people know about it. Involve the whole school community as much as possible, including senior leaders, governors and parents. Having a student or staff focus group on equality can help.



3. Look at the school policy on gender equality. This should be available on the school website and the gold standard is to set targets which are then actioned.
4. Consider the impact of one-off, large events compared to regular, small and perhaps more manageable change. A simple change to classroom practice could be using "Picklers" or mini white boards to ensure all students are involved in the lesson.
5. Change to group activities. This can enable all students to develop their practical and collaborative skills.
6. Explore unconscious bias. Most of us have a bias towards or against different groups of people, and it is nearly always unconscious. Simply being aware of our biases can really make a difference. You can test your unconscious bias online.
7. Embed into current school practice. Identify ways in which gender stereotyping, unconscious bias awareness and careers information can be slotted into current school practice, e.g. tutorials, assemblies, PSHCE and staff CPD sessions.

For more information: visit stimulatingphysics.org/igb

Signal boost



STIMULATING
PHYSICS
NETWORK

Girls in Physics Workshop

Teachers in Suffolk can explore a suite of resources to improve gender balance – and ensure that all students have a positive experience of physics in the classroom. You will challenge stereotypes and teach with renewed confidence. Held at Bury St Edmunds County Upper School on 8 July. Book your place for this workshop: npayne@bsecus.org. Find more local workshops at stimulatingphysics.org/regions.

#InMyShoes

Summer term's digital highlight is [#InMyShoes](https://twitter.com/InMyShoes). Search the hashtag on Twitter to find female scientists sharing images of their shoes/workplaces in support of a young girl denied dinosaur shoes. These images also form a quirky – yet accessible – careers resource for female students. Read the full story at bit.ly/imsMa15.

Summer term highlights from across the regions

- More than 200 pupils took part in our Extreme Physics competition at Barnard Castle School, Durham, featuring skydiving, rock-climbing and brushboarding.
- 215 trainee teachers joined our early-career mentoring programme.
- The North West gained a new Teaching and Learning Coach, Darren Forbes.
- 393 users contributed to our live [#IGBconf](https://twitter.com/IGBconf) discussion on Twitter.
- Registration opened for our Summer Schools, with 85 teachers registered to date.
- Christina Astin (South East Teaching and Learning Coach) ran a squashed tomato challenge for pupils at Hartsdown Academy, Kent, as part of Science Week 2015.



Twitter

Follow [@TakeOnPhysics](https://twitter.com/TakeOnPhysics) to connect with the wider physics community.



Useful resources

- Online: unconscious bias test from Project Implicit, implicit.harvard.edu/implicit
- Booklet: *Not for People Like Me?* Under-represented groups in science, technology and engineering. A summary of the evidence: the facts, the fiction and what we should do next, by A Macdonald (2014)
- Workshop: "Science: it's a People Thing", by the IOP, bit.ly/siapt
- Book: *Genderwatch: Still Watching*, by Myers et al. (2007)
- Booklet: *Girls in the Physics Classroom* A review of the research on girls' participation in physics, by Murphy and Whitelegg (2006)

Outreach

Lab in a Lorry takes science on the road

This summer, IOP's two Lab in a Lorry mobile outreach vehicles will be touring new regions. Lab 1 will be visiting schools in Scotland until July, when it will complete its tour for the academic year having visited 53 schools and reached more than 9700 children aged 11–14.

Meanwhile, Lab 2 will be touring five schools in Yorkshire, Herefordshire and Worcestershire in May, thanks to a partnership with Kingspan Insulation, before heading to East Anglia (with support from The Vinten Trust) in June and July to visit a further seven schools.



Lab in a Lorry inspiring pupils from West Somerset Community College with on-board science experiments.

Lab in a Lorry is not only a great way for young people to get hands-on science experience and meet scientists and engineers from the real world, but is also a chance for IOP members and STEMNET Ambassadors to enhance their communication skills through volunteering with a Lab in a Lorry.

For more information: visit www.labinalorry.org.uk where schools can request a visit or individuals can register as a potential volunteer to help inspire the next generation of physicists.

Teacher event

National Astronomy Meeting hosts teacher day

The National Astronomy Meeting (NAM) is one of the biggest meetings of astronomers in the country and this year it will take place in Llandudno, Wales, 5–9 July. The programme will include plenary talks by Dr Matt Taylor, Prof. Jo Dunkley and Lord Martin Rees, and an extensive public outreach programme.

The Royal Astronomical Society has hosted NAM for many years but this year there is a significant first: as part of the programme there will be a special educator training day, “Bringing Space to the



Advancing Astronomy and Geophysics

Classroom”. The educator training session is scheduled for 8 July at Venue Cymru Llandudno, Wales.

The session is a full-day event for up to 50 attendees and will cover all aspects of teaching (from primary through to Key Stage 5), laboratory techniques and demonstrations, specialised equipment and resources. There will also be a teacher pack to take away filled with resources.

The programme will: bring together different educator groups; include talks on a wide

range of subjects; foster networks, learning and wonder; and provoke conversations that matter.

Bursaries will be available to enable teachers to attend the conference. The bursaries are offered by the National Schools Observatory and The Ogden Trust, and will cover the cost of registration (free via the link below) and travel expenses up to £50 (subject to distance, this amount may be increased).

For more information: on the programme, visit bit.ly/1J6Gd6G and to register, visit bit.ly/10GQiuG.

Student competition

Hampshire students find winning Formula

Evolution F1, a team of students from Robert May's School, Hampshire, jumped onto the top step of the podium at F1 in Schools UK national finals, taking the national champions' crown and with it a place at the world finals in Singapore.

The national finals brought together the top 26 teams from around the UK, who had been shortlisted from nine regional events held earlier this year. The teams were challenged to design, build and race a miniature F1 car. During the final two days, the entries were judged in a number of categories including “scrutineering”, engineering, verbal presentation and display. Each car's speed was also assessed on a bespoke 20-metre test track, which the model cars covered in just over a second.

The winning team was presented with the national champions' trophy and,



The Evolution F1 team (from left to right): Oliver Curry, 14; Christopher McLennan, 16; Katie Halley, 15; Helen Jarman, 15; Rachel Scott, 15; and Rob Arthur, 16.

as well as securing a trip to Singapore, the team will visit the Formula 1 British Grand Prix (courtesy of Silverstone). Two members of the team also won £5000 per year bursaries for the duration of their

mechanical engineering degree courses at UCL Engineering.

For more information: visit www.f1inschools.co.uk

EVENTS FOR TEACHERS

27th Rugby Meeting

Rugby School, Warwickshire
4 June

This annual meeting for physics teachers will feature lectures given by leading research physicists and physics education experts, hands-on workshops where you can pick up new ideas and an opportunity to browse the extensive exhibition area. Details and booking: www.iop.org/rugby

SHAP Update One-Day Workshops

London 2 June

York 11 June

Bristol 16 June

One-day update courses on the new spec and practical requirements, for teachers already familiar with Salters Horners Advanced Physics (SHAP). Details and booking: bit.ly/1IOLeE4

SHAP Preparation Workshop

University of York

8–9 June

A residential course for teachers/technicians who are preparing to use SHAP for the new Edexcel/Pearson AS/A-level physics course. Details and booking: bit.ly/1IOLeE4

North Wales Teacher Network Conference

Bangor University

9 June

The conference is free for anyone who teaches physics at any level or who is interested in physics education. The costs for the conference are met by the IOP and the programme consists of a mixture of talks and workshops. Details and booking: Andrea Fesmer (andrea.fesmer@talk21.com).

Exoplanets and the Nature of Otherworlds

Berrill Lecture Theatre, Open University

9 June, 7.30 p.m.

The discovery of exoplanets sparked a revolution in astronomy and captured our imagination. Today, about 1000 such objects have been found, but their nature remains mysterious. Details and booking: Prof. Ray Mackintosh (raymond.mackintosh@open.ac.uk).

SPN South West Physics Day

Lange Energy Centre, Plymouth

19 June

All teachers of physics, technicians and trainees welcome. This popular day features a mix of practical workshops, inspiring talks and congenial networking. For 2015 only: an option to see the Combined Cycle Gas Turbine in action. Details and booking: sics.ac.uk/rp003.

Science on Stage

Queen Mary University of London

19 June

There will be more than 200 stands from primary and secondary school teachers, plus talks, workshops, shows and more. Places are limited, £10 booking fee applies. Details and booking: www.scienceonstage.org.uk.

A Day for Everyone Teaching Physics

Sjøvoll Centre at Pity Me, Durham

25 June

This conference provides the opportunity to explore new resources for teaching physics in the classroom, and also the chance to develop an understanding of some of the latest developments in physics. There will be sessions for those new to the subject as well as experienced teachers. Details and booking: bit.ly/1GP1yEh

Physics Subject Knowledge Booster Course

Charterhouse School, Surrey

29 June – 3 July and 6–10 July

GCSE and A-level subject knowledge boosters. Fully residential and free. Details and booking: Steve Hearn (science@charterhouse.org.uk).

Talk Science

Science Museum, London 2 July

National Railway Museum, York 7 July

These practical one-day courses for KS3 and KS4 teachers provide tools and techniques for engaging students in topical science stories. Create “powerful questions” to stimulate discussion, develop your facilitation skills and try activities to get students voicing their opinions. Free to attend, lunch and refreshments included. Details and booking: www.sciencemuseum.org.uk/talkscienceteachercourse

Bringing Space to the Classroom

Venue Cymru Llandudno, Wales

8 July

Teacher bursaries are available for this full-day event covering all aspects of teaching astronomy, from primary through to post-16, laboratory techniques and demonstrations of specialised equipment and resources. Booking: bit.ly/10GQiuG

Astronomy Education Summer School

Burlington House, Piccadilly, London

20–24 July

Around 60 teachers from across Europe will attend general lectures and workshops in astronomy. Highlights include an expedition to Greenwich and guest lecture by Martin Rees. Details and booking: www.eaae-astronomy.org or Alan Pickwick (Alan_C_Pickwick@btinternet.com or call 0161 973 6796).

Geoscience Education Academy

The Geological Society, London

23–26 July

This Academy provides curriculum-led training and support for science teachers across the UK. It is free, with UK travel reimbursed and accommodation included. Details and booking: www.geolsoc.org.uk/gea.

East Midlands Network Day

Sir Jonathan North CC, Leicester

26 September

Programme will include a lecture, workshops (KS3 and 4) and free raffle. New this year is a strand of three workshops designed for A-level teachers. Details and booking: Helen Pollard (helen.pollard@iop.org).

EVENTS FOR STUDENTS

National Women in Engineering Day

23 June

Help focus attention on great opportunities for girls and women in engineering by, for example, inviting a female engineer to speak at your school or visit a local engineering company. Details: www.nwed.org.uk.

Phantastic Physics 2015

King Edward VI School, Bury St Edmunds

2 July

Uppingham Community College

3 July

A competition for teams of four Y9 students. For details and to register your school team: Gerry Blake in East Anglia (gerry.blake@iop.org) or Helen Pollard in the East Midlands (helen.pollard@iop.org).

The Big Bang Fair Near Me

A free hands-on science day with exhibitions and workshops from local, national and international STEM organisations, as well as a student competition. Find out more at www.thebigbangfair.co.uk/nearme.

The Big Bang Fair Yorkshire & Humber

Doncaster Racecourse 23 June

The Big Bang Fair South West

The University of Exeter 25 June

The Big Bang Fair South East

South of England Showground 30 June

The Big Bang Fair London East

Newham College 30 June

The Big Bang Fair London Centre

Westminster Kingsway College 1 July

The Big Bang Fair London North

Stanmore College 3 July

The Big Bang Fair Eastern

IWM Duxford 8 July

Magnetic fruit and levitating frogs

The following demonstration can be used in a lesson to show that all materials can be magnetic.

Materials needed

- Two grapes
- A straw
- Watch glass
- Glass beaker
- Drawing pin

Demonstration

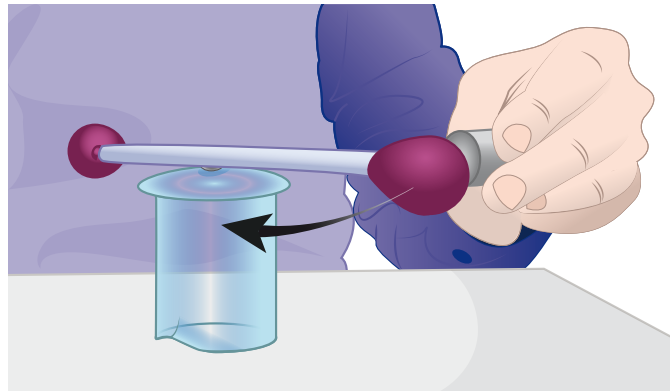
Push a drawing pin through the middle of the straw and attach one grape to each end of the straw. Invert the beaker and place a watch glass on top. Place the drawing pin (which is attached to the straw–grapes arrangement) on top of the watch glass. Move the grapes along the straw until the straw–grapes arrangement is balanced about the drawing pin. Bring a neodymium magnet up to one of the grapes and watch the grape move away due to the repulsive force.

Explanation

Students should be familiar with electromagnets. With a little prompting they should be able to extend this idea to atoms. Your students will probably think that only certain materials such as metals are magnetic and so will be surprised that the grape is repelled.

To explain this phenomenon, first remind them that the current responsible for the magnetic field of an electromagnet is created by electrons travelling in circles. Also remind them that atoms consist of electrons orbiting the nucleus. As a consequence, atoms create magnetic fields. In some materials the magnetism is strong, while in others it is much weaker. Although the detail of atomic magnetism requires an understanding well beyond key stage 4, they should be able to grasp the underlying principle: atomic magnetism is caused by moving electrons and, as a consequence, all materials are magnetic to varying degrees.

In “magnetic materials” such as steel, the atoms themselves behave like little magnets. Bringing a neodymium magnet close to the material causes the atoms to align to the external magnetic field and the steel is attracted. Such materials can remain magnetised even after the neodymium magnet has been removed.



Demonstrating diamagnetism by repelling a grape with a magnet.

In “non-magnetic” materials such as the grape, this is not the case. The atoms do not behave like magnets. This can be understood with a simple model of an atom with two orbiting electrons. If the electrons orbit in opposite directions, their magnetic effects cancel each other out. However, all substances can be made magnetic by the application of a magnetic field. This distorts the electron orbits in the atoms and molecules. This type of magnetism, known as diamagnetism, is temporary, occurs in all materials and is entirely a consequence of the applied field; further, it acts in a direction such that it is repelled by the field that is causing it, hence the grape is pushed away.

Diamagnetism is a weak effect, therefore it is important to ensure the straw–grapes arrangement pivots with very little friction for this demonstration to work. In graphite the effect is 40 times stronger and can be demonstrated by levitating a piece of pyrolytic graphite above a set of rare earth magnets. Pyrolytic graphite levitation kits are commercially available. The lesson can be further extended to include discussion around the magnetic levitation of a frog film clip (see below), for which Andre Geim, along with Michael Berry, received an Ig Nobel Prize in 2000. Andre Geim was the first scientist to receive both a Nobel and Ig Nobel Prize.

For more information: on diamagnetic levitation, visit bit.ly/1JgoFIP. For details of how to build a levitation experiment, visit www.instructables.com/id/Diamagnetic-Levitation-Experiment. Pyrolytic graphite levitation kits are available from Mindsets at bit.ly/1Gavsx0. More information about levitating frogs can be found via bit.ly/1JxhoB5.