IOP | Institute of Physics
Education *Supporting Teachers*

Classroomphysics

The newsletter for affiliated schools

December 2008 Issue 7

Dr Jon Marchant (Liverpool Telescope Project)

The Liverpool Telescope on La Palma: a robotic astronomical telescope owned and operated by Liverpool JMU, with financial support from the STFC.

Stellar lecture tour sets its sights on schools in 2009

Next year is the International Year of Astronomy (IYA) celebrating the 400th anniversary of Galileo's use of the telescope to study the night sky. The IYA is intended to stimulate interest not only in astronomy but also in science in general, with a particular slant towards young people. The anniversary will mark the enormous progress that has been made during the past four centuries, both in our knowledge of the universe and in the tools that we use to study it.

It is fitting that the Institute's Schools and Colleges Lecture 2009, entitled "Exploring the universe: a tale of telescopes, time travel and extraterrestrials", will show how modern telescopes can be used by astronomers to look at the universe in ever greater detail. Due to progress in technology, astronomers can now observe things farther and farther away and therefore farther back in time. The lecture will show how these observations can be used to learn more about the origins and future of the universe and our place within it.

The talk will involve hands-on demonstrations, giving students the opportunity to do some astronomy themselves using some of the most advanced telescopes in the world. The free lecture lasts an hour and is suitable for those aged 14 plus. It will be touring the UK throughout 2009.

Dr Newsam looks forward to sharing his passion for astrophysics with schoolchildren during IYA 2009.

Dr Andrew Newsam is a reader in astronomy education at the Astrophysics Research Institute, Liverpool John Moores University, where he specialises in turning sets of astronomical data into a collection of useful numbers that can be used to do science. He is also director of the National Schools' Observatory (www.schoolsobservatory.org.uk), a project aimed at giving schoolchildren the opportunity to make their own observations alongside professional astronomers by using a top-quality research telescope.

For more information: visit www.iop.org, select "Schools and Colleges" and then go to "Events" for further details about venues and lecture bookings.

Editorial

Welcome to the last issue of *Classroom Physics* in 2008. Your pupils will no doubt be thinking of all things festive while you are desperately trying to hold on until the end of term and get to the end of your "to-do" list.

Our Schools Lecture for 2009 has an astronomical theme and is featured on the front page. It ties in with 2009 being the International Year of Astronomy. Information about obtaining a free school telescope is on p5.

An important new online resource for teachers and students has just been launched. Future Morph aims to provide comprehensive information about careers using science and mathematics (p3). Other resources to support your teaching directly are the new Inspiring Seas (p3) and Colliding Particles websites (p5). Inspiring Seas has a range of engaging marine-related support material and Colliding Particles is a developing series of short videos following a research group at CERN.

We have news of a new event taking place during National Science and Engineering Week: the inaugural Big Bang Fair (p5). Also, there is a reminder about entries for the SciCast Physics film-making competition (p2).

LabAid, an important charity that supports schools in developing countries by donating refurbished equipment from UK schools, is featured on p2.

If you are thinking of broadening your experiences or would like to share your expertise with a non-physics colleague, you may be interested in the teacher fellowship scheme in Wales (p2) or the Science Additional Specialism course (p4). We also have news of our 2009 awards for teachers with details about the nomination process (p4). We want to support and celebrate excellent physics teaching in all kinds of school.

Personnel changes in the Institute's education department are detailed (p4) along with upcoming events for teachers and students (p6). There is a thought-provoking demonstration for teaching about weightlessness (p7) and a measurement activity (p8).

A questionnaire about *Classroom Physics* is enclosed for you to give us some feedback about the newsletter. Your comments are always appreciated.

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

Charity helps teachers in developing countries

Every year, British schools discard huge amounts of laboratory apparatus, yet at the same time, schools in developing countries struggle to teach chemistry, physics and biology with little or no equipment.

For nearly 20 years, LabAid, now a registered charity, has, from its base in Amersham, Buckinghamshire, tried to change this imbalance. Apparatus donated by schools is gathered in Amersham, where a team of volunteers sorts and checks it, overhauls it, if necessary, then packs it for shipment. So far, schools in 18 countries have benefited from the 5 tonnes of equipment now dispatched each year – a drop in the ocean, perhaps, but the impact on individuals can be profound. As the headmaster of a secondary school said: "We received laboratory equipment from you three years ago and our science teaching has so improved that one of our students, for the first time in our history, has just been admitted to medical school."

However, so much more could be done. LabAid needs more volunteers to help with the collection and transport of equipment to Amersham from all over the country; storage, long term or short term; and work on the laboratory apparatus at LabAid's premises or at home. Any help would be gratefully received and would boost the amount of equipment going to schools in developing countries.

Rwandan teachers using donated apparatus.

For more information: visit www.labaid.org, or contact Peter Tall or Alan Welch (e-mail labaidtrust@yahoo.co.uk).

SciCast calls for film entries

SciCast Physics, the competition for scientists of all ages, is well under way, but there is still time to enter before the 9 January 2009 deadline. Films should explain a principle of physics (in less than two-and-a-half minutes) in an entertaining and innovative way to non-scientists, and entries can be submitted in any format.

Guidelines, rules, tips and entry details are all online. SciCast Physics is part of Planet SciCast, which is a partnership between NESTA, the Institute of Physics and the Engineering and Technology Board.

For more information: visit www.planet-scicast.com/physics.

Institute offers teacher fellowships in 2009

Are you a physics specialist in a Welsh secondary school or further education college? If so, there are secondment opportunities available, through the Institute's Stimulating Physics programme, in Welsh university physics departments, focusing on the transition between school and university physics. The scheme is funded by the higher education funding councils for England and Wales. It aims to increase the number of students studying physics at A-level and university.

Secondments are offered on a part-time basis and the aims include:

- advising on existing A-level curricula;
- adapting the university's physics curriculum and teaching practices;
- advising the physics department on student recruitment and its "reaching wider" policies.

Applicants should submit a CV with a covering letter by 15 January 2009, explaining how they would fulfil the objectives of the fellowship. Mae cyfleoedd am secondiad ar gael yn adrannau ffiseg prifysgolion Cymru – holwch am yr opsiwn o secondiad drwy gyfrwng y Gymraeg.

For more information: visit www.stimulatingphysics.org or contact Dr A M Thomas, Stimulating Physics in Wales manager (e-mail physics@iopwales.org).

Interactive site teaches the appliance of science

The world of work is rapidly changing. Just think how much it has altered in the last 10 years with the rise of the internet and e-mail. Science- and mathematics-related subjects equip young people with skills and knowledge that will help them to adapt to whatever the future holds.

The Future Morph website at www.futuremorph.org has been created to help 11–19-year-olds to engage with science and mathematics at school and to appreciate the huge breadth of opportunities that are available as a result of studying science, engineering or mathematics at post-16 level. The site shows just how valuable these subjects are for modern life and roles in all sectors of employment – they are not a one-track path to life in a laboratory but instead they can help to keep students' options open beyond school or college.

Future Morph is part-funded by the Department for Children, Schools and Families, and it has been developed by the Science Council as part of a wider Careers from Science project with involvement from the Institute of Physics, the Association for Science Education, the Royal Society of Chemistry and many others.

The site includes sections for teachers, careers advisers and parents, as well as three sections for students in the 11–14, 14–16 and 16–19 age ranges. Content for teachers includes:

- resources for teaching KS3/S1–2 science with a world-of-work context, including video profiles and practical activities;
- where to find other careers-related resources;
- advice on engaging your students (e.g. how to find speakers);
- listings of available careers information and links to careers sites.

New content, including multimedia and interactive elements, is being used to pull together existing material with an ethos that is strongly audience driven. The video profile of a glass artist talking about how she uses science won an award even before the full site was launched, so be sure to take a look.

For more information: visit http://www.futuremorph.org.

Innovative marine-themed resource will make enquiry-based teaching feel like plain sailing

The Inspiring Seas project is a partnership between the School of Marine Science and Technology at Newcastle University and NYK Group Europe Ltd. It aims to provide teaching and learning resources at KS3 concerning all things marine.

The project's teaching activities put theory from the National Curriculum into practice by providing students with real-life insights into marine science and technology issues that require practical solutions. As such, the resource aims to develop and maintain young peoples' interest and engagement with science, design and technology, and citizenship-related subjects.

Piloted activities have provided first-hand experience of real-world science to school groups nationwide. Particular highlights included "Ship-shape!", a hands-on activity exploring the physics-related principles behind ship design, and "Food for thought", an interactive online game that helps students to develop their ecological skills.

The partnership's efforts have culminated in the launch of a dedicated website that provides a diverse range of stimulating material, including six marine-themed cross-curricular modules and careers profiles from those working in the maritime world, and interactive software. The resources are all geared towards enquiry-based learning in line with the new National Curriculum.

KS3 science students have a whale of a time exploring the physics that underlies ship design.

For more information: visit www.inspiringseas.co.uk to explore oceans of interactive resources that will liven up KS3 physics and technology teaching.

New physics-related material should expand students' vocational horizons

The Institute of Physics is in the process of updating its careers material. The new *Expand* leaflet promoting A-level physics to 14–16-year-olds is included with this issue of *Classroom Physics*. New material across the full 11–19-year-old age range will become available in 2009, including a new careers section on *physics.org*.

For more information: To keep up to date with all of the currently available physics-related careers resources, visit www.iop.org/careers.

Education team embraces restructure

There have been a number of changes made in the Institute's Education Department over the last few months and we thought that it would be helpful for you to be able to match names to faces when contacting us.

At the end of October we said goodbye to Daniel Sandford Smith, head of pre-19 education. He worked as part of the team for more than five years and oversaw a significant expansion in the work of the department, during a time of substantial curriculum change and pressures on physics education. He will be greatly missed but we are very happy to welcome Charles Tracy as his replacement. He has been managing part of the Stimulating Physics project for the last two years.

Joanne Page left the department in the summer to start postgraduate training as a medical physicist. Clare Mills, in an internal move, has replaced her and is your point of contact for the Institute's Schools and Colleges Lecture and small-grant scheme.

Left to right: Gita Tailor, Charles Tracy, Leila Solomon, Taj Bhutta and Clare Mills.

Taj Bhutta joined the department in the summer and has been hard at work revising careers material for various age ranges in school. He is the person to contact with any queries about careers events or materials.

Leila Solomon and Gita Tailor are the longest-serving members of the department and many of you will have had contact with them over the years. Leila organises Physics Updates and Physics in Perspective among her other roles, as well as sending out resources on request. Gita is the affiliated schools administrator and she deals with updating our records and sending out renewal reminders as part of that work. If you have any query about payments or any other aspect of the affiliation scheme, she is the person to contact.

There are several other people who work on a number of different projects in the department and you can find out more about them in the next issue.

Awards call for nominations

Do you know a great classroom-physics specialist or primary-science teacher? Do you have an inspirational and dedicated colleague? If so, why not nominate them for the Teachers of Physics/Primary Science Awards? This is a good way to acknowledge and celebrate their work and to give teachers the recognition that they deserve.

There are several awards available for teachers of physics and primary science. Nominations can come from a variety of sources, including headteachers, colleagues, governors, advisers, Institute branch representatives, parents and even students. The winners will be chosen by a panel of current and former teachers and there are no restrictions on the number of awards in each category. The panel is looking for teachers who:

- are outstanding teachers of physics;
- have inspired pupils and colleagues;
- have made physics exciting and relevant with an effort beyond the call of the timetable;
- have engaged professionally with others beyond the school gates.

Award-winners typically have a minimum of 10 years' teaching experience. Good nominations tend to use anecdotes and examples to bring classroom experiences to life and explain why the teacher makes a difference. Evidence from students or former pupils is particularly helpful in illustrating a teacher's exceptional qualities.

The Institute is now accepting nominations for the 2009 awards. If you know of an excellent teacher who you think deserves recognition, we would be delighted to hear from you. We would welcome more nominations from the primary sector in particular. Nominated teachers must still be teaching physics/science for most of their working time. The deadline is 31 May 2009.

For more information: Nomination forms can be requested from Gita Tailor (e-mail gita.tailor@iop.org, tel 020 7470 4823) or can be found online at www.iop.org/activity/education/. Completed forms can be submitted either electronically or by post. These awards are for citizens of the UK and Ireland only.

New national CPD course will help science teachers to specialise in physics

The Training and Development Agency (TDA) for Schools, in close consultation with the science community, including the Institute of Physics and the Royal Society of Chemistry has developed a CPD course for physics and chemistry teachers. Following on from a pilot, the course will be available across England from summer 2009 and will be entitled Science as an Additional Specialism Programme (SASP): physics or chemistry.

SASP is aimed at teachers of physics who don't have a PGCE or first degree in the subject. The course will develop participants' subject and pedagogical knowledge in physics. On successful completion, participants will be able to teach physics more effectively, with enthusiasm and confidence, to students aged 11–19 years in schools or further education colleges. The equivalent CPD course is also available for teachers of chemistry who don't have a PGCE or first degree in the subject.

Keith Gibbs ensures that teachers measure up.

To be eligible to attend the physics course, applicants must be teaching physics to students aged 11–19 (in schools or colleges), have qualified teacher status and have completed their NQT year.

The course will run for up to 40 days (although the structure and length will be flexible to reflect the needs of participants), spread over an intensive summer start and the following full academic year, and will comprise tuition and in-school development. It will offer academic accreditation. The TDA will fund supply cover for participating schools, and teachers meeting eligibility criteria will receive a £5000 incentive on successful completion of the course.

For more information: visit www.tda.gov.uk/sciencecpdcourse. If you are interested in applying for a place on a nearby SASP course from summer 2009, note that details of course providers will be available online from January 2009.

Institute backs big event

Making science engaging and interesting to young people can be challenging in the confines of the classroom. With this in mind, the Institute of Physics is partnering with other organisations to launch the inaugural Big Bang Fair. The event will take place on 4–6 March 2009 at the Queen Elizabeth II Centre, London, and will kick-start National Science and Engineering Week. This groundbreaking initiative will help to celebrate and raise the profile of young people's innovation and achievement in science and engineering throughout the UK.

The fair will be an experience to remember and will encourage students to take part in science and engineering initiatives with support from their parents and teachers. Inspirational and challenging presentations, shows, workshops and interactive exhibits by leading engineers, scientists and entrepreneurs will engage all attendees. The event will include the national celebrations for the CREST and Young Engineers schemes, and it will be the place where the first ever National Science Competition is judged and awarded, giving students recognition for their talent and providing an incentive for their peers.

This is an opportunity for young adults to think about themselves, their world and their role within it. Through the range of exhibits and events at the fair, students will discover the huge variety of opportunities that exist for those with science and engineering qualifications. Expert advice will be on offer to guide students and to provide them with information about the extensive range of career options available. Partnering organisations hope that the event will form the foundation for a lasting legacy and raise the profile of the UK as a science and engineering innovator.

The Big Bang
UK Young Scientists & Engineers Fair

For more information: visit www.tbbf.com and www.nationalsciencecompetition.org/.

A particle-physics research team hard at work preparing for the Large Hadron Collider start-up.

Online resource focuses in on how science works at CERN

The Large Hadron Collider (LHC) at CERN, Geneva, will look deeper into the nature of the universe than anything that has gone before it, and its vast experiments are certain to change our understanding of the physical world around us.

Colliding Particles is a series of films following the work of one team of physicists involved in the experiments at CERN. Over the course of the project, the series will document the researchers' work at the frontiers of particle physics, charting the hunt for the elusive Higgs and exploring the workings of the scientific process.

The project is designed to support the KS4 How Science Works element of the National Curriculum. The films have been made to illustrate aspects of the way in which science develops, following an exciting and ongoing process of discovery, and they have a natural "story" thread running through them. The documentaries show scientists discussing their latest research, how they collaborate and compete, and the relationship between experiment and theory in particle physics.

Episodes are available online, along with a "classroom edit" of each film broken down into sections to accompany the teachers' notes and PowerPoint presentation.
Mike Paterson

For more information: visit http://www.collidingparticles.com.

Initiative offers free telescopes for schools

Would your school like a free telescope to help it to celebrate the International Year of Astronomy (IYA)? Funded by the Science and Technology Facilities Council, the Society for Popular Astronomy (SPA) is making 1000 small but high-quality free telescopes (70 mm refractor with tripod) available to support science education, and your secondary school can get one by writing a simple plan outlining how you would use it to support and enrich the teaching and learning of science.

The SPA will provide a DVD (funded by the Royal Astronomical Society) and website containing information about how to set up the telescope, how to draw the Moon, and what planets and other objects of interest to observe and when. There will also be interviews with astronomers of all ages and ideas for projects and support materials.
Helen Walker, president of the SPA

For more information: visit www.popastro.com or contact the SPA (e-mail IYA2009@popastro.com).

Free telescopes: schools count their lucky stars.

Events

National Science and Engineering Week
6–15 March
This year the theme for the week is "change". This fits with Darwin 200 (a programme of events celebrating Charles Darwin's discoveries) and the International Year of Astronomy, both happening in 2009.
Visit www.the-ba.net for more information about running activities and to find out what might be happening in your area.
Details: contact a member of the organising team (e-mail nsew@the-ba.net).

EVENTS FOR TEACHERS

ASE Annual Conference
University of Reading
8–10 January
This three-day event will give delegates the opportunity to meet the Institute's education team and to enjoy varied workshops and lectures, as well as a major exhibition of resources and apparatus. The conference will include the John Lewis Lecture, entitled "Climate change: a risky business", given by Geoff Jenkins, and sessions run by the Institute's Teacher Network.
Details: visit www.ase.org.uk.

The Scottish Science Education Conference: Real World Science
Dunblane Hydro Hotel, Dunblane, Perthshire
6–7 March
Enrich your teaching and learning with Real World Science, organised by the ASE and SSERC, with a keynote address given by Prof. Michael Reiss.
Details: visit http://www.asescotland.org.uk/ and http://www.sserc.org.uk/ or contact Sheila MacLellan (e-mail cpd@sserc.org.uk).

Physics Update
School of Physics and Astronomy, University of Manchester
3–5 April
This three-day residential course offers an exciting programme of lectures and workshops, with a tour of the research laboratories.
Accommodation: Chancellors Hotel and Conference Centre, Manchester.
Details and booking: contact Leila Solomon (e-mail leila.solomon@iop.org).

Salters Horners Advanced Physics Residential Courses
University of York
30 March – 1 April: A2 preparation, teachers course
31 March – 1 April: AS and A2 preparation, technicians course
15–17 July: AS preparation, teachers course
Details and booking: visit www.york.ac.uk/org/seg/salters/physics or contact Sandra Wilmott (e-mail slw5@york.ac.uk).

Institute of Physics North Wales Teacher Network Conference
The School of Education, Bangor University
2 June
This event is open to all physics teachers, with a day of workshops, lectures and opportunites to network.
Details: contact Andrea Fesmer (e-mail andrea.fesmer@talk21.com).

Stirling Physics Meeting
University of Stirling
3 June
This event features a day of lectures and workshops, along with an exhibition.
Details: visit http://www.iopscotland.org.

Rugby Physics Meeting
Rugby School
4 June
This one-day event for teachers in schools and colleges will offer delegates information, stimulation and communication. It will include an exhibition and workshops.
Details: contact Leila Solomon (e-mail leila.solomon@iop.org).

Oxford Physics Meeting
Department of Physics, University of Oxford
23 June
This Teacher Network conference will consist of a programme of lectures and workshops.
Details: contact Robert Strawson (e-mail robert@strawson.net).

North East Physics Teachers Conference
University of Durham
24 June
Details: contact Ruth Wiltsher (e-mail ruth.wiltsher@physics.org).

Annual Liverpool Physics Teachers Conference
Chadwick Laboratory, University of Liverpool
2 July
Details: contact Steve Barrett (e-mail s.d.barrett@liv.ac.uk).

Advancing Physics Teachers and Technicians Courses
Department of Physics and Astronomy, University of Birmingham
30 June: AS preparation, teachers course
1 July: A2 preparation, teachers course
2 July: AS and A2 preparation, technicians course
These courses cover all aspects of teaching and learning and are for those new to Advancing Physics, as well as for those who feel the need to do a bit of catching up.
Details and booking: www.advancingphysics.iop.org.

EVENTS FOR STUDENTS

Schools and Colleges Lecture 2009: Exploring the Universe: a Tale of Telescopes, Time Travel and Extraterrestrials
This free lecture for 14–16-year-olds, given by Dr Andy Newsom, will be touring the UK.
Details and booking: visit www.iop.org and select "Events" under "Schools and Colleges" or contact Clare Mills (e-mail clare.mills@iop.org).

Physics in Perspective
University College London and the Royal Institution
15–17 February
This is a three-day course for sixth-formers and college students, with the purpose of bringing to participants some of the excitement, relevance and fun of physics. It consists of a series of six lectures or lecture-demonstrations. Free time is scheduled in to allow participants an opportunity to explore other aspects of London. Discounted accommodation is available through Minerva Travel.
Details: contact Leila Solomon (e-mail leila.solomon@iop.org, tel 020 7470 4821).

The South West Branch of the Institute of Physics Festival of Physics
Redland Green School, Redland Court Road, Bristol BS6 7EF
21 March, 10.00 a.m. – 4.00 p.m.
This annual festival will include talks and demonstrations accessible to physics students, and a free lunch for those who book in advance.
Details: http://sw.iop.org.

National Particle Physics Masterclasses
This is a popular series of one-day events for sixth-form students and their teachers, run by practising particle-physics researchers at various institutes across the country during March and April.
Details and dates: visit http://www.particlephysics.ac.uk/teach.html or contact the STFC schools' officer, Gareth James (e-mail gareth.james@stfc.ac.uk).

Advancing Physics Revision Roadshow
All venues will feature sessions for both AS and A2 students.
2 April: University of Bristol
20 April: University of Birmingham
21 April: University of Durham
23 and 24 April: University College London
Cost: £20 per student, which includes revision sessions, hand-outs, lunch and refreshments. Accompanying teachers are admitted free of charge. Book early to avoid disappointment.
Details and booking: visit http://advancingphysics.iop.org.

Demonstrating weightlessness

This is an experiment to show that in free fall it is not gravity that disappears but the contact force with a surface. This is how we usually "feel" our weight.

Apparatus and materials

- two 1 kg masses connected by a spring
- a board with a high-friction surface, such as a rubber mat or fine sandpaper attached to it
- sandbags or expanded polystyrene packaging to protect the floor

Technical notes

The masses should be able to sit on the high-friction surface with the spring stretched between them without moving. Once lifted off the surface, the masses should move quickly together.

Safety

When dropping heavy masses, ensure that they fall onto the sandbags or other suitable cushion and that everyone watching is standing well clear of the landing site.

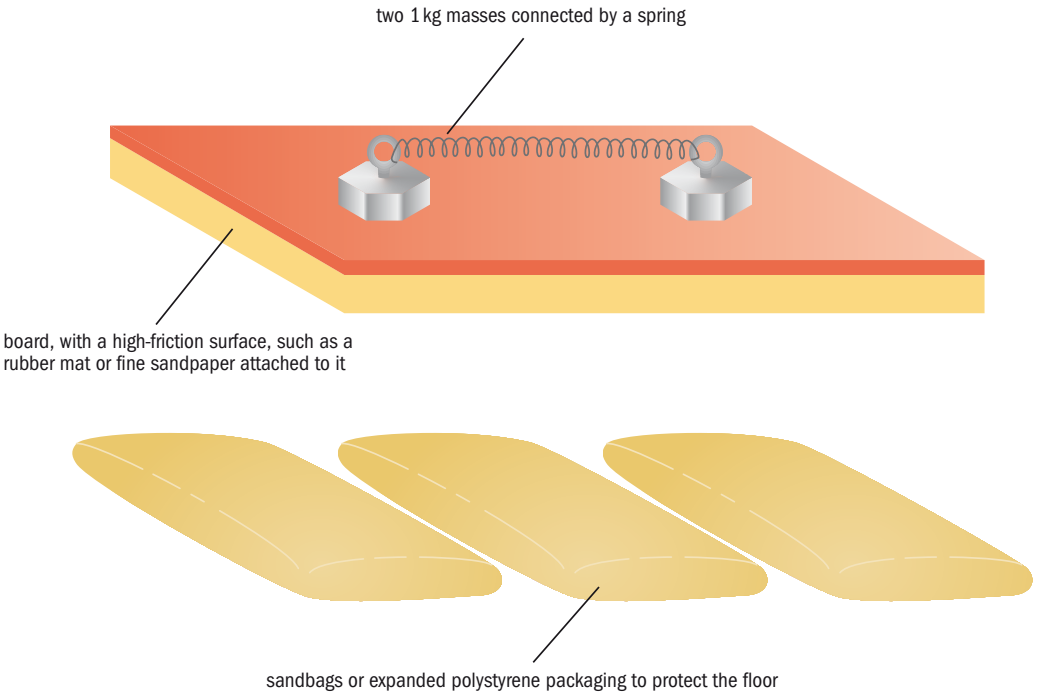
Procedure

1. Place both masses on the board, with the spring stretched between them.
2. Explain that the only reason the masses do not move together is because of the friction. Demonstrate this by moving them to a lower-friction surface, such as a benchtop.
3. Hold the board horizontally above the sandbags and ask what will happen when the board is dropped. Demonstrate.
4. Now the follow-up: repeat the experiment but say that you are going to throw the board upwards. Again, ask what will happen.

Teaching notes

1. While the board is held at rest there is a force between it and the masses. This leads to friction (proportional to the normal force and the coefficient of friction). Once the board is dropped it is apparent that the friction disappears, although the masses may remain in contact with the board. This is an indication that there is no interaction between two objects in free fall together. We normally feel our weight as a result of the contact force from the ground pushing us up, so this absence is manifested as a feeling of weightlessness. Is it truly weightless? That depends on your definition. If weight is the force of gravity then no – clearly gravity is pulling the board and masses down. However, the term weightless has come to mean this odd situation, for example, which astronauts find themselves in, and so we have to accept that terminology.
2. Throwing the board up will cause confusion and the students will expect the two masses to start moving once the board peaks. In fact they will start to move immediately. Why? This is because they are in free fall, regardless of which way they are moving. An astronaut may be in free fall, accelerating towards the centre of the Earth, but moving always at right angles to that direction. This is a very important point: that acceleration and velocity can be in different directions.

This experiment was submitted to *practicalphysics.org* by **Ken Zetie**, head of physics at St Paul's School, London.



Worksheet teaching notes: 'Determining the thickness of a sheet of paper'

The activity overleaf is intended to introduce students to a technique for measuring the size of tiny objects. It can also be used to discuss the use of significant figures in recording measurements.

The experiment could be extended to determining the average thickness of tissue paper using a light source and light sensor/LDR.

Another possible extension would be to set the challenge of getting the average weight of a pea without counting – it could be set up as being quite tedious to count all of those peas and sheets of paper. This could lead into the Millikan technique (not necessarily related to the Millikan experiment – just an interesting technique for finding a constant value).

In Millikan's method for money, students find the mass of a single coin by measuring handfuls of coins. The mass of a single coin represents the basic unit of charge. The handfuls represent the charge on an oil drop.

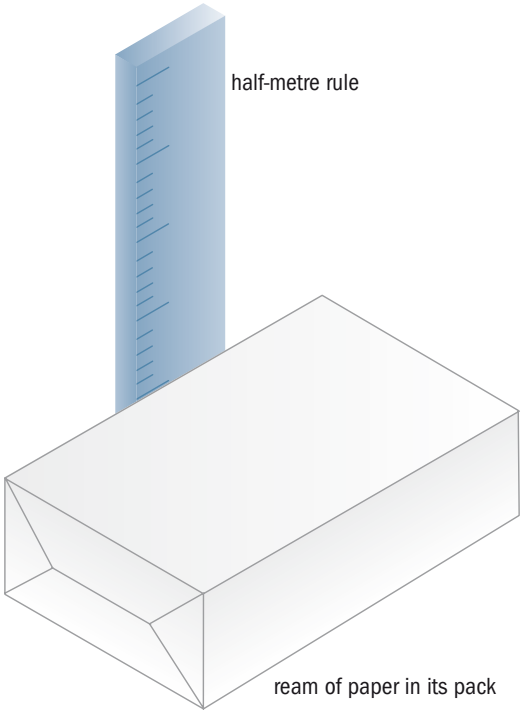
For more information: visit http://www.practicalphysics.org/go/Experiment_1036.html.

Worksheet

Determining the thickness of a sheet of paper

Class activity
An experiment to measure multiple objects to find the size of one of them, when the objects are too thin or small to measure individually.

Apparatus
For each student group:
- a half-metre rule with gradations in millimetres
- a ream of photocopy paper in its pack



Procedure
1. Estimate the thickness of one sheet of paper.

My estimate is ..... mm.

2. Measure the thickness of the pack of paper in mm.

Our pack of paper is ..... mm thick.

3. Find out how many sheets of paper are in the pack.

There are ..... sheets in the pack.

4. Calculate the average thickness of one sheet of paper.

The average thickness of one sheet of paper is ..... mm.

(Hint: divide the answer to step 2 by the answer to step 3.)

5. Were you a good estimator? .....
Explain your answer.
.....
.....
.....

(Extension)
6. Does it matter whether you took account of the packaging in your answer to step 3?
Explain your answer.
.....
.....
.....

(Homework/extension)
7. Find the mass of a single frozen pea using the same method.