IOP | Institute of Physics
Education *Supporting Teachers*

Classroomphysics

The newsletter for affiliated schools

December 2016 Issue 39

Awards

IOP celebrates teachers of physics

Theresa Conlon, Kendrick School, Reading. "An outstanding teacher and educator ... her motto 'Physics is Fun' reflects her approach."

Máire Duffy, Clonkeen College, County Dublin. "Hard working and selfless ... she has created a fantastic reputation for physics in her school."

Martin Guy, St Albans School, Hertfordshire. "Has recruited and developed a very strong team and inspired many to read physics at university."

Jennie Hargreaves, Lockerbie Academy, Dumfriesshire. "Popular with students and highly respected by her peers ... keenly involved in regional events."

Shane Jenkins, Gwernyfed High School, Brecon. "Commands the respect of students with teaching that is contemporary, relevant and rigorous."

Ralston West, London Academy, Edgware. "His commitment extends beyond the classroom, supporting staff and students to improve."

IOP

Congratulations to the winners of the 2016 IOP Teachers of Physics awards. They come from around the UK, from different types of schools and are at various stages of their career. But all bring something special to their teaching.

The IOP's president, Professor Roy Sambles, said: "It is a delight to celebrate those who helped to nurture the intellectual development of students and inspire the next generation to study physics. I warmly congratulate these six individuals for their outstanding contributions to educating the scientists of tomorrow."

The Teachers of Physics awards recognise and celebrate the success of secondary school teachers who, by their outstanding practice in the classroom, have raised the status of physics and science in schools. The winners each receive a £300 prize, plus a crystal paperweight and certificate, presented at the annual IOP Awards ceremony.

More information about this year's Teachers of Physics awards at bit.ly/IOPteachawards16.

IOP medals to reflect impact of teaching on physics

Changes to the Institute of Physics Awards will ensure that the importance of physics education is recognised and celebrated at the very highest level.

From 2017 the **Lawrence Bragg gold medal** will be awarded for outstanding and sustained contributions to physics education and to widening participation within it. This brings it into line with the Institute's other gold medals, which recognise contributions to physics by people with an international reputation.

A further two new medals celebrating remarkable contributions to physics education will be open for nominations each year.

The Lawrence Bragg Medal and Prize

W Lawrence Bragg had an international reputation for the popularisation and teaching of physics. He won the 1915 Nobel Prize in Physics at the age of just 25.

The **silver Marie Curie-Sklodowska medal** will be awarded for distinguished contributions to physics education and to widening participation within it.

The **bronze Daphne Jackson medal** will be awarded for exceptional early-career contributions to physics education and to widening participation within it.

The IOP has revised its entire portfolio of medals to reflect the breadth of the physics community, more explicitly recognising remarkable people at each career stage. In particular, this continues to show how the IOP values teachers and educators.

Nominate a brilliant physics teacher for IOP awards or medals at iop.org/awards.

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

In this issue

Editorial

Welcome to this edition of *Classroom Physics*. Each year we recognise six physics teachers for their outstanding contribution to physics through our Teachers of Physics awards. This year's winners are examples of just some of the inspiring and excellent practice that takes place in schools across the UK on a daily basis (page 1).

If you know a brilliant physics teacher, please do nominate them. Not only is it a great opportunity for winners to come to the IOP and meet other physicists at the award ceremony – spotlighting the work of teachers is vital to the future of UK physics.

If you've never tried play-dough circuits, follow our festive Teaching Tip on page 8. They are an engaging way to explore electric circuits through creative play and will be as popular with your final-year students as with your 11 year olds. The worksheet on page 7 guides students through a simple exploration of parallel and series circuits. Next, challenge them to introduce more complex components in their circuits and explore other shapes for their dough models.

Affiliated schools will receive with this edition:

- Higgs Hunters teacher booklet (see article on page 4).
- Illustrator Elise Gravel's poster "Some Famous Women Scientists".
- Two sheets of Marvin and Milo reward stickers.
- A flyer advertising the University of Kent's residential astronomy summer school.
- Postcards from IntoFilm highlighting the careers available for students interested in the visual effects and games industry.

The next *Classroom Physics* will be our 40th edition, marking 10 years since the newsletter began. Look out for a special Teaching Tip insert!

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Photography by **Daniel Josman**

Teacher conference

Free places at ASE 2017

The Association for Science Education
Promoting Excellence in Science Teaching and Learning

Schools are invited to share what they have been doing in class in exchange for a free place at the Association for Science Education's Annual Conference.

ASE 2017 will run from 4 to 7 January at the University of Reading. Teachers from primary, secondary and further education are invited to come and display a piece of work, whether a top tip, a resource or a project at the Schools' Exhibition from 9am to 12pm on Friday 6 January. You will have a poster board and a table so that conference delegates can see the ideas and chat to you about your work.

IOP at ASE

We'll be running two Improving Gender Balance workshops at this year's ASE conference, based on our whole-school approach and how to introduce it in your school. We'll also be hosting a Talking Science Debate and launching a new data website.

As well as a free teacher place, there is also support available for schools that would like to bring students to talk about their work.

To register your school for the exhibition, email nicola@seventhcorner.co.uk.
ASE 2017 info at ase.org.uk/conferences/annual-conference/.

Teacher CPD

Most northerly IOP workshop of 2016

In September, six of the eight physics teachers in the Shetland Islands attended a CPD day led by local IOP Teacher Network Co-ordinator Stuart Farmer (winner of the 2016 IOP Lawrence Bragg Medal). This picture shows them measuring the expansion of the universe using a rainbow eraser.

Stuart Farmer

To find a workshop near you, visit iop.org/network and contact your local Teacher Network Co-ordinator.

Teacher recruitment

Will your school be recruiting a trainee physics teacher this year?

2017 PHYSICS TEACHER TRAINING SCHOLARSHIPS

The IOP is committed to reducing the shortage of specialist physics teachers. So, if your school is looking to recruit trainee physics teachers through School Direct, we can offer you help with marketing your position. Sign up to the IOP School Direct Registration Programme to receive copies of our teacher recruitment marketing materials, plus the opportunity to list recruitment events on the IOP website and marketing advice.

Do encourage prospective applicants to apply for an IOP Physics Teaching Scholarship. Now in its sixth consecutive year, our scholarship scheme has supported more than 550 teachers through their training year.

This year, we hope to award 150 scholarships worth £30,000 to outstanding individuals entering teacher training in September 2017. Successful scholars benefit from a package of support including IOP membership and masterclasses designed to develop additional skills and discover new ways to teach topics.

Scholarship applicants should have at least a 2.1 degree in physics or a related subject.

Register for IOP School Direct support at iop.org/schooldirect.
More information on scholarships at iop.org/scholarships including eligibility criteria.

Girls in physics

Who shouts loudest in your physics lessons?

Boys still dominate the classroom, despite the best intentions of teachers, according to observations carried out by the Institute of Physics' Improving Gender Balance project.

Over the last two years, we have been working closely with a small number of schools to trial interventions that aim to increase the proportion of girls studying A-level physics. As part of this support, we carried out a series of physics lesson observations in 97 classes across 11 schools and provided teachers with detailed feedback.

The research showed that boys tended to take part in more interactions than girls. Although teachers were directing their questions to boys and girls proportionately, the observations revealed that boys were significantly more likely to raise their hands – and twice as likely to call out answers. Boys were also 50% more likely to ask questions.

Jessica Rowson, IOP Girls in Physics project manager said, "How classroom interactions are managed can affect how students feel about a subject. We recommend that teachers are aware of the gender balance of interactions in the physics classroom, and consider reducing the use of hands up or calling out answers if appropriate. We found that lesson observations, used as part of a supportive environment, were a useful way to explore this."

She added that, although the data comes from a limited sample space (the observations took place in schools that have signed up to work on a gender balance project), the results show trends that appear to reflect the more formal research evidence.

iStock

Observations have shown that boys are more likely to raise their hands in physics lessons than girls.

To address teacher–student relationships plus guidance on alternative questioning techniques, download IOP's *Girls in the Physics Classroom: A teachers' guide for action* at iop.org/girlsinphysics. Teachers' self-evaluation sheet: bit.ly/IGBselfeval.

tp TalkPhysics discussion at bit.ly/TPboysdom.

Physics on trend

The physics of bottle flipping

In case you missed it, the bottle-flip craze was an internet-driven fad that swept the country earlier this year. The challenge is to flip a partially filled water bottle and try to make it land upright. It is quite a striking phenomenon in which the bottle appears to stop rotating before performing a vertical descent.

Recording the motion and playing it back in slow-motion helps reveal what is going on. As the bottle moves through the air, the liquid inside it starts to climb the sides. This increases the bottle's moment of inertia and so decreases its rotational speed, much like a high diver who extends his arms and legs to slow his spin.

Trying different amounts of water shows how important it is to get the amount of liquid right. The trick just doesn't work with a full bottle. The liquid can't move, and its higher centre of mass means that a full bottle topples over when it lands. Filling it to just a bit below a third seems to be optimal.

A complete analysis of the motion is complex, so you may want to discuss it qualitatively to illustrate how familiar concepts such as centre-of-mass and parabolic motion apply to more complex systems. Your students could also carry out their own investigations by making slow-motion videos with different bottle shapes and liquid levels.

IOP

For more information: watch our slow-motion video of the water-bottle flip challenge at bit.ly/IOPbottle.

Taj Bhutta is school support manager at the Institute.

Women in physics

Represent the UK in physics teaching

Are you a female physics teacher who would like to share her career experiences? Or, as a teacher, is the pipeline of female physicists close to your heart? If so, join the IOP team representing the UK at ICWIP 2017 – that is the Sixth International Union of Pure and Applied Physics International Conference on Women in Physics.

The conference will take place at the University of Birmingham on 16–20 July, and will focus on developments in the status and retention of women physicists. Recommendations from the conference are sent to physics institutions and professional bodies worldwide.

The IOP's UK team will be drawn from all areas of physics education, research and employment and at a variety of career stages.

For more information: visit bit.ly/ICWIP. To join our team, contact Jessica.wade08@imperial.ac.uk or barbara.gabrys@materials.ox.ac.uk. The application deadline is 15 December 2016.

Student science

IRIS on the lookout for Higgs Hunters

Nobel Prize winner Professor Peter Higgs recently launched a new mission for classroom physicists: to spot the decay of the Higgs particle.

School students will be helping a team of particle physicists from the University of Oxford who are studying data from the Large Hadron Collider (LHC) where, in 2012, the Higgs boson was discovered.

Every day the Oxford team receive, process and analyse gigabytes of data. This is created when two beams of protons collide at near-on the speed of light, producing new, short-lifetime particles that decay into a shower of exotic particles. With so much data, they need help.

Jade and Poppy, Tiamat Film

IRIS director Becky Parker greets Peter Higgs.

The mission for your students is to spot the two tracks that sprout from "off-centre vertices", characterising Higgs particle decay.

The challenge is one of a range of school-based research projects run by the Institute for Research in Schools (IRIS), which enables more than 230 schools worldwide to contribute authentic scientific research to the academic community. Each project is accompanied by accredited teacher CPD, a curriculum-linked resource pack and partnership with a local university or industry. Alongside their A-levels and GCSEs, IRIS students have published in academic journals, delivered TEDx talks and appeared on the national news.

For more information: visit researchinschools.org/higgs_hunters.

Careers

Research placements and STEM experience days

Students in the first year of a post-16 STEM qualification are invited to apply for a Nuffield Research Placement.

Every summer, more than 1000 students across the UK are offered the opportunity to conduct four-to-six-week research projects to get hands-on experience of what scientific research is really like. Placements may be in universities, research institutes or companies.

Nuffield encourages students without a family history of going to university or who are from low-income households to apply. All students receive travel costs and some may receive a weekly bursary.

Jasmin's Nuffield placement was with the Quantifying Brain Microvasculature Project at the University of Nottingham's School of Physics and Astronomy

Nuffield Foundation

"I am passionate about science, physics in particular – the medical applications of the subject greatly appeal to me. My Nuffield placement enabled me to pursue this interest through conducting my own research in a professional environment – a rare opportunity for a student of my age. I thoroughly enjoyed the experience!"

Nuffield Foundation

First Edition EDT

Meanwhile, the Engineering Development Trust's First Edition programme is celebrating its most successful year yet, having run 280 events reaching 22,000 students aged 11–16. These included STEM experience days and STEM Family Challenge events designed to increase parental involvement with STEM subjects and careers. Both workshops are designed to excite and enlighten students on how STEM is fun, interesting and results in a rewarding career.

More information on Nuffield placements: nuffieldresearchplacements.org.

More information on EDT First Edition: www.etrust.org.uk/first-edition or email firstedition@etrust.org.uk.

Student outreach

Apply physics anywhere... even the Death Star

Look out for the fortnightly video series from Queen Mary University of London's School of Physics and Astronomy. It's a great way to engage enthusiastic GCSE and A-level physicists who are also fans of film, television and computer games.

This month, QMUL outreach officer Martin Archer asks whether we could build a space station like the Death Star from *Star Wars* and the new *Rogue One* movie. The video covers topics such as gravity, centrifugal and tidal forces and Hooke's law.

Steve Jurvetson, Menlo Park, USA

Martin explains, "One of the best things about physics is that at its heart are bunches of concepts that can be applied to seemingly disparate areas and result in the fascinatingly complex universe that we observe. By breaking problems down to such core concepts, physicists can tackle not only the outstanding questions in our quest to understand nature but also completely unfamiliar areas, even those not normally associated with the subject."

He uses this principle in all the videos, questioning some of the best-known movies, shows and games as well as shining a light on some of the latest research results.

Watch the videos at: youtube.com/martinarcherdr.

Out of the classroom

Science Museum's revamped gallery great for physics

London's Science Museum launched its new £6 million interactive gallery, Wonderlab, in October. We sent IGB manager Jessica Rowson to review the exhibits from a physics teacher's point of view.


Science Museum

Friction slides with astroturf, plastic and bowling alley surfaces.

"The museum's goal is for Wonderlab to double the number of school visitors compared to its predecessor, Launchpad. The new gallery is 60% larger than Launchpad, with 50 exhibits across seven zones: forces, light, sound, space, electricity, mathematics and matter.

Some exhibits have been refreshed from Launchpad and are reliable hands-on activities, without which the science museum would be incomplete: building a bridge, investigating prisms, constructing an electric circuit and – the physics favourite – a cloud chamber.

But most have either been selected as 'the best' from museums across the globe or have not been seen in a science museum before. There are friction slides, a million volt Tesla coil and a chemistry bar where you can 'order' an experiment from a menu that includes sweets in liquid nitrogen and levitating superconductors.

There is a new exhibition space offering a choice of four 20-minute long shows with subjects ranging from rockets and electricity to engineering and explosions. A lot of the shows are aimed at ages 7–14, but older students are not neglected with KS4 days, coding workshops, ethical debates and master classes planned.

The main downside is that non-school visitors and families now have to pay, but the museum is working with charities to increase free access for disadvantaged young people. Special provision is made for home educators."

Visit: sciencemuseum.org.uk/wonderlab, or follow @ScienceMuseum and #wonderis. School groups can book a free visit via the museum's education booking line on 0207 942 4777. Sign up for the museum's education newsletter at sciencemuseum.org.uk/educators.

Health and safety

The use of air rifles in schools

Does your physics department have an air rifle? If so, it is important to check that it is correctly licenced.

In Scotland, a change to the law means that from the end of December this year it will be an offence to use, possess, purchase or acquire an air weapon without holding a certificate.

The Scottish Schools Education Research Centre said, "In a school situation, this means that someone should hold an air weapon certificate for the rifle. It would make sense for this to be a member of the physics department. This person should always supervise its use. The licence is not transferable – if the holder moves to a new school, a new licence will be required. If you have an air rifle and no longer want to keep it, you can hand it in to a police station."

In England and Wales, a licence is only required for air rifles if the muzzle energy of the pellet exceeds 16.25 J. In Northern Ireland and the Republic of Ireland, all air rifles require licences.


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More information on the Scottish law at airweapon.scot/how-to-apply.

PRACTICAL PHYSICS

Practical activities involving air rifles and their safe use are available at: practicalphysics.org/speed-rifle-pellet-momentum.html.

STIMULATING PHYSICS NETWORK

What happens next?

13 December. Tunbridge Wells Grammar School for Boys, TN4 9XB

Join Physics Network Co-ordinator Darrell Hamilton to explore a series of demonstrations, posing the question to your class: "What happens next?". Register at talkphysics.org/events/what-happens-next/.

Teaching resources from the Rosetta mission

This issue's digital highlight is Teach with Rosetta. To celebrate the extraordinary success of the European Space Agency's Rosetta mission, extend your students' physics experience with a few secondary-level space-science lessons. Cook yourself up a comet nucleus (better still, supervise your students doing it) in the classroom with a few simple ingredients. Inspire AS/A2 students as they model ellipses with marbles. More information at bit.ly/teachwithrosetta.

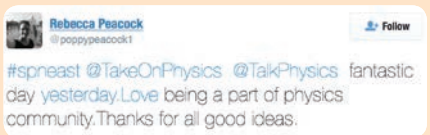
Autumn activities across the regions

- The Dean Academy became our latest Partner School in the South West.
- More than 140 teachers attended SPN regional days in Peterborough and Cambridge, sharing their experiences on Twitter using #SPNeast and #SPEED2016.
- The Priory Academy LSST became our latest Link School with Adviser in the Midlands.
- Physics Network Co-ordinator Niloufar Wijetunge ran a series of informal, interactive workshops in South East schools on energy.
- Physics Network Co-ordinator David Cotton presented his top-five static electricity demos in one of the latest Talking Physics webinars. Catch up at bit.ly/talking-physics.

Find SPN activities near you at stimulatingphysics.org/regions-events.

Community

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



Events

EVENTS FOR TEACHERS

Isaac Physics Teacher CPD
University of Central Lancashire, PR1 2HE
12 December 2016
This course is designed for KS5 physics teachers who want to become involved with the Isaac physics project. Details and booking: bit.ly/IsaacCPD.

Getting to Grips with A-level Physics
Mathematics and Science Learning Centre, SO17 1BJ
12 December 2016
Ideal for teachers who are new to teaching physics and who want to build subject knowledge and confidence. Details and booking: bit.ly/PhysicsALevel.

Engaging and Ensuring Progress of Low Attainers in Science
Eaton Bank Academy, CW12 1NT
16 December 2016
This course will provide strategies to improve the progress made by low attaining students, including the identification of common science misconceptions. Details and booking: bit.ly/Lowattainers.

A Day for Everyone Teaching Physics
School of Physics and Astronomy, University of Leeds
5 January 2017
This day for everyone teaching physics is a mix of practical workshops, inspiring talks and congenial networking. Sessions concentrate on ideas to use in your labs and classrooms. Details and booking: bit.ly/Day4everyone.

Physics Booster Course – Electricity Basics
Charterhouse School, Godalming
14 January 2017
The programme will concentrate on subject knowledge and developing insight and understanding. Details and booking: email science@charterhouse.org.uk.

Particle and Atomic Physics
Ruislip High School, London
18 January 2017
This session will focus on common misconceptions, the required practicals and ideas to encourage the participation of girls in physics activities. Details and booking: email niloufar@wijetunge.com.

talkphysics

Find physics teachers' events near you at talkphysics.org/events.

Physics Booster Course – Electricity and Magnetism
Charterhouse School, Godalming
21 January 2017
The programme will concentrate on subject knowledge and developing insight and understanding. Details and booking: email science@charterhouse.org.uk.

GCSE Practicals 2
Brooke Weston Teaching School, Corby
3 February 2017
Designed to enable teachers and technicians who are supporting practical work in the new GCSE physics courses. Details and booking: bit.ly/GCSEPraticals2.

Physics Booster Course – Waves and Sounds
Charterhouse School, Godalming
4 February 2017
The programme will concentrate on subject knowledge and developing insight and understanding. Details and booking: email Science@charterhouse.org.uk.

Electricity
Sir Christopher Hatton Academy, Wellingborough
7 February 2017
Aimed at non-specialist physics teachers in secondary schools, each session includes two practical elements as well as a dedicated maths element. Details and booking: bit.ly/ElectricityCPD.

EVENTS FOR STUDENTS

Weather Balloon Competition
11–16 students are invited to design and build a science experiment to be carried through the atmosphere by a weather balloon. The winning entry will be invited to build and launch their experiment. For more information, visit bit.ly/RmetsCompetition.

Salter's Festivals of Chemistry
March to June 2017
A series of one-day events in association with The Royal Society of Chemistry providing students with the opportunity to experience hands-on practical chemistry challenges and CPD and networking opportunities for teachers. For more information: festivalsofchemistry.co.uk.

PSST! TSST?

Teacher Subject Specialism Training in Physics (England)

Are you a non-specialist who teaches physics? Or are you looking for ways to enable non-specialist colleagues to teach physics? Physics TSST courses are free to participants and usually take place in term-time. They are run by schools and funded by the Department for Education. The IOP co-ordinates a community-approval process for these courses. More info, including course listings, at iop.org/tsst.

FUNDING DEADLINES

IOP School Grants

One-off grants of up to £600 for projects or events linked to teaching or promoting physics and engineering in UK schools and colleges for students aged 5–19 years. Deadlines for 2017: 1 February, 1 June and 1 November. For more information and a downloadable application form, visit iop.org/schoolgrants.

SAVE THE DATE

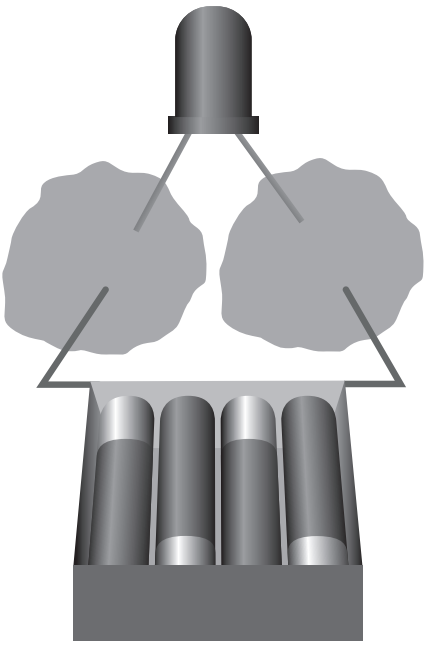
IOP Rugby Meeting
The 29th Annual Meeting for Teachers of Physics in Schools & Colleges
Rugby School
8 June 2017

Our one-day meeting at Rugby School for teachers of physics in schools and colleges, and teachers in training. Details, booking and presentations from this year's meeting: iop.org/rugby or join our TalkPhysics group: bit.ly/RugbyTeacherMeeting.

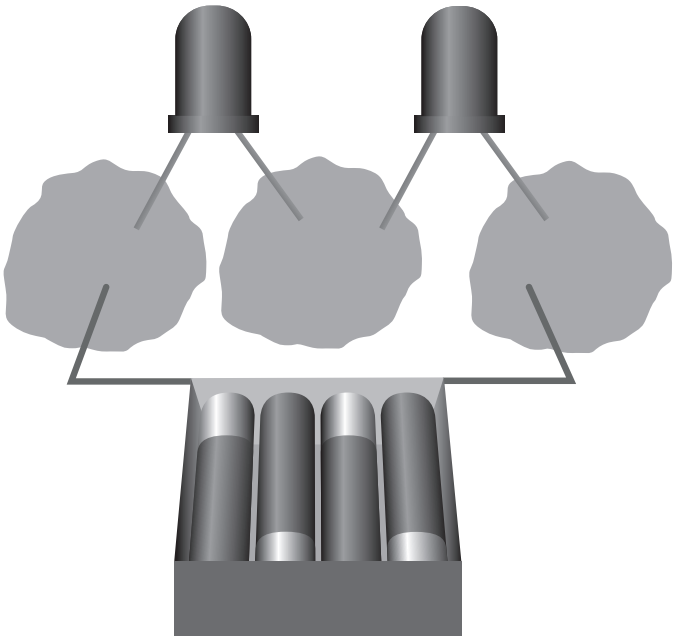
Teachers' notes on worksheet (page 7)

Typical responses might be: 1. Pushing the dough together creates a short circuit. The current will flow through the dough rather than the LED.
2. Dimmer. Putting the LEDs in series increases the total resistance of the circuit. The current through each LED is reduced.
3. Same. Although putting the components in parallel halves the total resistance of the circuit, the current splits in a parallel circuit and so the current through each LED will be (approximately) the same as in circuit 1.

Play-dough circuits



Circuit 1.



Circuit 2.

Start by setting up a circuit with one LED (circuit 1). If the LED doesn't light up, check all the connections and make sure that the LED is the right way round.

1. Push the two lumps of dough together to form one lump. The LED goes out. Can you explain why?

Now make a **series** circuit with two LEDs (circuit 2).

2. Compared with circuit 1, are the LEDs in circuit 2 brighter, dimmer or the same? Can you explain why?

Now build a third circuit with two LEDs in **parallel**. You should decide on your own method on how to do this.

3. Compared with circuit 1, are the LEDs in your parallel circuit brighter, dimmer or the same? Can you explain why?

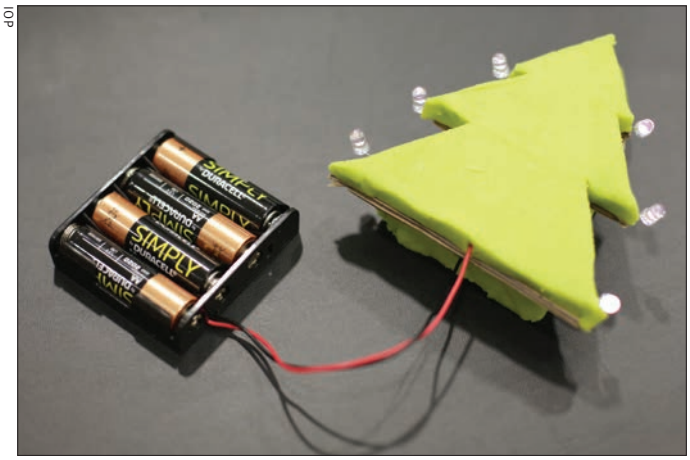
Equipment needed

- Conducting dough
- 6 V power supply
- Two LEDs

The LED will only work in one direction. Make sure that the longer terminal of the LED is attached to the dough with the positive (red) wire from the battery pack.

Teachers' notes on page 6.

Merry Squishmas: play-dough circuits



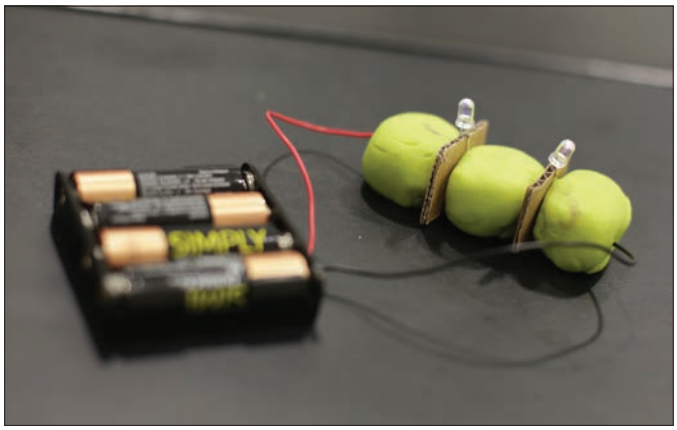


Figure 1. Series circuit with two LEDs.

To celebrate the end of term, why not get your class to build a festive circuit out of conductive play dough? Although commercially available, it is cheaper to make your own dough before the lesson. This teaching tip is about building a Christmas-tree circuit, but challenge your students to think about making conducting circuits in other seasonal shapes or using other circuit components. There is a related worksheet on page 7.

Materials required per group

- A ball of conductive dough (approx. 175 g)
- Four AA batteries
- One battery pack to hold four AA batteries
- Six or more LEDs
- Cardboard (approximately 10 cm × 10 cm)
- Scissors

The activity

Divide the class into groups. The number of groups will depend on how much dough you have prepared. Introduce the activity by explaining that the added salt makes the green dough an electrical conductor. For older students you may also want to add that this is because sodium-chloride dissociates into charged sodium (Na^+) and chlorine (Cl^-) ions, meaning that the dough contains charged particles that are free to move.

Give each group two LEDs and ask them to investigate both series and parallel circuits. Discuss why an insulator (either cardboard or air) is needed between the layers of dough. Remind students that the LEDs will only light up if they are connected the right way around (i.e. the long arm of the LED is connected to positive).

Once they have familiarised themselves with building simple play-dough circuits, they should design and build their own Christmas tree with six or more working LED lights. Encourage them to think about which type of circuit is best (series or parallel) and how they will use the cardboard as an insulator to ensure that the LEDs will all work.

Acknowledgements

With thanks to the Squishy Circuits Project at St Thomas University, Minnesota, for permission to adapt their worksheet and reproduce their dough recipe. Visit stthomas.edu/squishycircuits for more classroom activities.

Ellen Phillips is assistant editor for *Classroom Physics*.

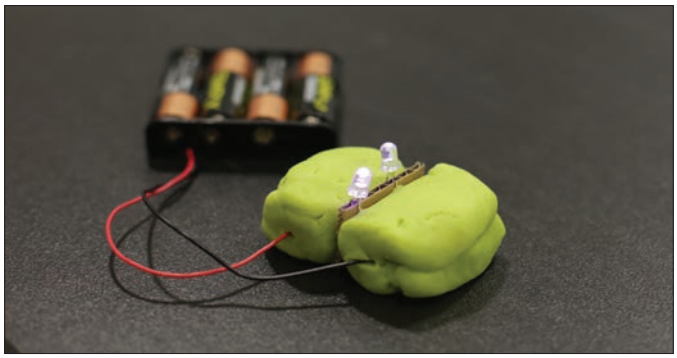


Figure 2. Parallel circuit with two LEDs.

Making your own conducting dough

The following recipe is quick and easy to make. It will produce 350 g of dough, enough for two groups to make a Christmas tree. You may need to make several batches.

- One cup of water
- One cup of flour (plus extra for dusting)
- ¼ cup of salt
- Nine tbsp. lemon juice
- One tbsp. vegetable oil
- Green food colouring

1. Combine the water, flour, salt, lemon juice, vegetable oil and food colouring in a medium-sized saucepan, and whisk to ensure a smooth consistency.
2. Cook over a medium heat, stirring continuously to ensure it doesn't burn. The mixture will begin to boil and start to thicken.
3. Keep stirring until the mixture forms a ball in the centre of the pot.
4. Once a ball forms, place on a floured surface and knead until the desired consistency is reached.

The dough will keep for several weeks when stored in an airtight container or plastic bag.

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