

# Classroomphysics

The newsletter for affiliated schools June 2016 Issue 37

## Online resource

# Teach science. Talk physics

Our digital forum for teachers, technicians and trainers has relaunched with new form and functionality. We have given TalkPhysics a fresh new interface and a great new search engine, which will make lesson planning, resource sharing, finding advice and networking even easier.

Over the past seven years, TalkPhysics has established itself as a space for the physics teaching community to intermingle, whether discussing the latest A-level practicals, asking for tips for interview lessons or posting pictures of unidentified kit found at the back of a cupboard.

### New: webinars

We're launching a series of webinars from the IOP's Physics Network Coordinators. You can tune in each month for a new take on classroom practice: we have webinars planned on *Thermal Imaging*, *Isaac Physics* and *Gender Balance*. First up: Dave Cotton (aka Twitter's @newmanphysics) counts down his *Top Five Static Demos*. Follow this series at [talkphysics.org/talkingphysics](http://talkphysics.org/talkingphysics).

### New: events calendar

Stay up-to-date with STEM CPD – and spread the word about your own workshop or #TeachMeet – with our new events calendar. All events are submitted by TalkPhysics members and can be linked to discussion groups so you can share resources and start networking. See [talkphysics.org/events](http://talkphysics.org/events).

### New: articles

We've got regular news, expert comment and updated resources on TalkPhysics, from the latest *Marvin and Milo* cartoons, to a how-to guide for our Exoplanet Physics resource. Throughout September, TalkPhysics will



The new and improved TalkPhysics is optimised for all platforms so you can access it anywhere.

### Start talking physics

- **Regular visitors:** let us know what you think of the relaunch at [talkphysics@iop.org](mailto:talkphysics@iop.org) or leave a comment on the website. We'll do our best to include your feedback in future development.
- **New users:** make sure you register in time for the new school year. It's easy to sign up at [talkphysics.org](http://talkphysics.org) and you will be able to build a personal learning network from more than 9,500 physics teaching professionals.

also host downloadable resources from the Improving Gender Balance team in Scotland and England ([talkphysics.org/genderbalance](http://talkphysics.org/genderbalance)). Browse at [talkphysics.org/articles](http://talkphysics.org/articles).

### Improved: activity and groups

The latest discussions are still visible on

the home page, but you can now filter your content with personalised interest groups and activity areas at [talkphysics.org/groups](http://talkphysics.org/groups) and [talkphysics.org/activity](http://talkphysics.org/activity). You can also create your own private group to talk confidentially with colleagues, and there are new permissions for group owners.

### Improved: forums

Our discussion forums are now easier to use, with nested comments, notifications, @mentions and a MathTex equation editor. You'll still be able to embed rich media, and attach and tag resources and favourite content to view later.

### Improved: intelligent search

We've made it more straightforward to find the discussions and resources relevant to you. Search results are weighted by date, keywords and tags, and you can filter search results directly by content type.

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

## In this issue



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Editorial



Welcome to the summer 2016 edition of *Classroom Physics*. The IOP education office is currently abuzz with an exciting new project that will revolutionise the way we provide online support to teachers. It will help you to grow your physics teaching expertise, as well as making it easier for you to find the right IOP resources to support your students' learning. We'll share more information in future editions.

We hope you've had a chance to explore the new TalkPhysics discussion forum (see page 1). To celebrate, we've enclosed some TalkPhysics-branded sticky notes. Whether you are a seasoned user or have never visited TalkPhysics before, do take a few minutes to explore the new site.

This issue comes with resources from the Institution of Engineering and Technology. These include a brochure outlining resources and funding and also some useful ideas for using the BBC Micro:bit. This small, programmable hardware device is being sent to every UK secondary school, addressed to computer science teachers. We hope you can trace the one sent to your school as these pocket-size computers have great potential in the physics lab.

We're also providing another SEP booklet, *Building Materials* full of classroom activities and materials that can be used in existing schemes of work. Physics themes include energy and its transfer, temperature and forces.

Finally, did you view the transit of Mercury (see *Classroom Physics* issue 36) in school? We'd love to hear your experiences and see your pictures. Email them to us and we'll give a prize to the best.

As ever, we always welcome your comments and suggestions on any area of this newsletter – or IOP support for teachers.

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Policy

# Is physics more difficult than football?

Charles Tracy reflects on whether this is a meaningful question:

“It is certainly true that physics has an unfortunate reputation for being difficult, whereas football does not – despite the fact that fewer people become professional footballers each year than take a first-class degree in physics.

“That reputation is both unwarranted and educationally unhelpful. I argue that both physics and its students would benefit if we could stop using the loaded and loosely applied language of difficulty.

“To give meaning to discussions relating to difficulty, we need to be specific about the aspect of difficulty we are referring to. And then define it. One aspect is the rarity of achieving a goal (pun intended!).

“For example, it is easy to carelessly say that physics is more difficult than biology. But this has no meaning.

“A meaningful question would be: is it rarer (for the same prior attainment) to get an A-grade in physics than an A-grade in biology at A-level? The answer is no. This question is precise and the answer is clear: getting an A in physics is no more unlikely than getting an A in biology. The two subjects are graded equally.

“Sadly, the same is not true for some other subjects. Physics is graded more severely than, say, psychology. However, although that feeds its reputation, it still does not mean that physics, as a whole, is ‘difficult’. It is simply – and outrageously – graded more severely (Ofqual take note). By being precise



Charles Tracy, IOP Head of Education.

we can avoid the term ‘difficult’.

“We can then be positive and inclusive in our language: physics is enlightening, well-regarded and rewards hard work; it provides sought-after thinking skills and all of its grades are a springboard to interesting occupations at many levels.

“Not everyone will become an Einstein, but they don't have to. Like football, physics can be practised at all levels. After all, a Pelé is rare, but people are quite happy to play football at a level that suits them – without ever calling it ‘difficult’.”

**For more information:** to read Charles' blogs on inter-subject comparability and to have your say, visit [iopblog.org/author/charles-tracy](http://iopblog.org/author/charles-tracy).

Teacher recruitment

## Do you know someone who wants to be a physics teacher?

The final deadline for this year's IOP Teacher Training Scholarships is 1 August. We have 150 scholarships, each worth £30,000, to award to trainee physics teachers starting in September. So far we have offered half of our allocations, but we need your support to help us achieve 150.

If your school is running a School Direct programme, candidates on the unsalaried route are eligible for scholarships. As well as financial support, our programme offers mentoring and help to build a community of support. Our Scholar events give the opportunity to learn from experts, exchange

### 2016 PHYSICS TEACHER TRAINING SCHOLARSHIPS

teaching tips and discover new ways to communicate physics. The 2015/16 Scholars have enjoyed a visit to the National Space Centre and a masterclass at the Manchester Museum of Science and Industry.

**For more information:** and to find out about eligibility, visit [iop.org/scholarships](http://iop.org/scholarships).

## Professional development

# Test your subject knowledge

What makes great teaching? The Sutton Trust asked this question in its 2014 report of the same title. They concluded that teachers' content knowledge – including their ability to understand how students think about a subject and identify common misconceptions – was critical to improving pupil attainment.

For some years, the IOP has been collaborating with the Gatsby Foundation to develop a diagnostic testing tool for teachers and their supporters.

Chris Shepherd, IOP Teacher Support Manager, said: "The evidence is clear: good subject knowledge is essential for effective physics teaching. Using a diagnostic testing tool is one means to help ensure that we have teachers with excellent knowledge. There is more to be done before the idea of diagnostic testing is embedded into training



The IOP's new diagnostic testing tool will help teachers and their supporters explore subject knowledge.

programmes but we hope this tool is a step on the way."

The tool can be used by staff involved in physics CPD to devise tests covering a range of physics topics, selecting questions from an extensive question bank. The questions are designed to delve into subject knowledge and identify misconceptions so that CPD can be accurately focused.

We also provide pre-set tests for those considering teacher training or assessing potential candidates. The tests would also be useful to people considering returning to teaching or to non-specialists embarking on teacher subject specialism training.

**For more information:** to build your own diagnostic tests visit [subjectknowledge.org](http://subjectknowledge.org). Or pre-set tests are available at [iop.org/diagnostic](http://iop.org/diagnostic).

## Early-career teachers

## Salaries for newly qualified teachers now available online

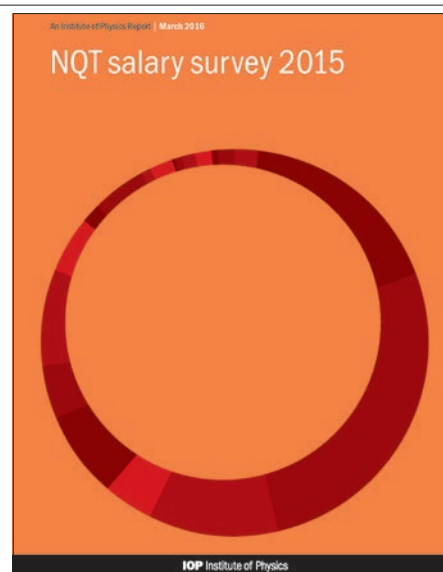
In our previous issue, we flagged up the results of our survey of starting salaries for new teachers. A technical glitch meant it did not go online in time. However, it is now available to download as a PDF at [bit.ly/NQTsalary](http://bit.ly/NQTsalary).

To recap: we analysed 225 responses from UK science and physics specialists who took up NQT positions between 2012 and 2015. The survey revealed that physics and physics with maths teachers started on an average salary of £24,800, about

£2,600 more than the minimum point on the national payscales. However, the range of salaries ran from £15,500 to £49,000.

Male NQTs were 1.5 times more likely to have negotiated their salaries. On average their starting salary was £2,000 higher than their female peers.

**For more information:** IOP advice for student teachers who are looking for their first qualified teacher position is available at [bit.ly/findNQTjob](http://bit.ly/findNQTjob).



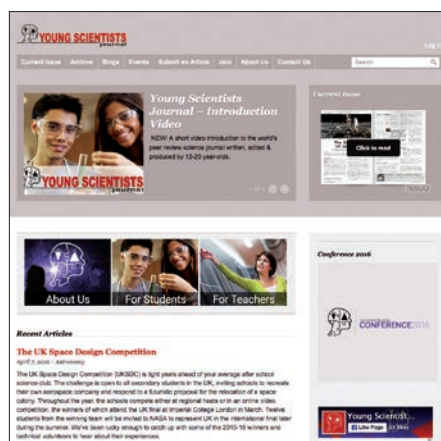
## Student science

## Peer-reviewed journal is by pupils for pupils

Encourage your young researchers to join the ranks of published scientists by getting involved with the *Young Scientists Journal*.

The journal, which is currently celebrating its tenth anniversary, was co-founded by IOP Teaching and Learning Coach Christina Astin. It is unique not only because it publishes articles written by young scientists aged between 12 and 20 years of age, but also because it is edited and marketed by young scientists.

Working with the journal allows students to enter into the world of scientific publishing and journalism, from submitting a piece of original research or a review article,



to editing submissions, web development and marketing. Articles and papers may have originated as coursework, an extended essay, CREST award or even just be an outstanding piece of homework.

Teachers can also get involved: by signing up as a hub school, teachers can mentor a group of students running various aspects of the journal.

**For more information:** or details on how to submit articles, visit [ysjournal.com](http://ysjournal.com). To become a hub school or a YSJ ambassador, email Christina at [cma@kings-school.co.uk](mailto:cma@kings-school.co.uk).



Teaching support

# The language of mathematics in science

New guides published by the Association for Science Education with the Nuffield Foundation aim to help ease the frustrations of applying mathematics in science lessons.

*The Language of Mathematics in Science: A Guide for Teachers of 11–16 Science*, and *The Language of Mathematics in Science: Teaching Approaches* have been designed to ensure that students can transfer their maths skills and understanding effectively.

Students can get confused when encountering mathematical ideas in science lessons because their science teachers are using different terminology or approaches to those they have learnt in maths lessons.

These books aim to achieve a common understanding of important terms and techniques between teachers, publishers and awarding bodies, not least because there will be a greater emphasis on maths skills in GCSE examinations from September 2018.

The first book focuses on different



aspects of scientific activity, such as data collection, analysis, looking for relationships, presenting data and using scientific models. There are explanations of important mathematical terms along with a glossary and guidance about good practice in applying mathematical ideas in science.

The second book outlines ways that science and maths departments have worked together, illustrating different approaches to teaching mathematical terms and applications.

Free *School Science Review* article for readers of *Classroom Physics*

**Promoting the understanding of mathematics in physics at secondary level** by Alaric Thompson ([bit.ly/mathsinphysics](http://bit.ly/mathsinphysics)).

This article explores some of the common mathematical difficulties for students, arguing that if they are taught the reasoning behind the processes, they are less likely to compartmentalise their learning. Strategies, particularly concerning the language of mathematics, are discussed.

**For more information:** the publications are available as free PDF downloads from [ase.org.uk/resources/maths-in-science](http://ase.org.uk/resources/maths-in-science). Some hard copies are available at £3.50 from ASE’s online bookstore.

Teaching resource

# Free asteroids available for classroom use

The School of Physical Sciences at the University of Kent has developed a new set of resources to bring small solar-system body research into the classroom – including a set of 3D printed asteroids.

The resources provide background information, lesson plans, slides and practical activities for teachers to use as one full body of work or to mix and match with curriculum topics. The materials are suitable for students aged between 11 and 16 years of age.

The project, funded by the Science and

Technology Facilities Council, aims to engage pupils by giving them an insight into real space-science research and linking this to their current studies. The practical activities are simplified versions of real observations that scientists make to determine key characteristics of asteroids such as their period and shape.

**For more information:** to trial these resources and receive a class set of 3D printed asteroids, please email [science@kent.ac.uk](mailto:science@kent.ac.uk).



A set of 3D printed asteroids.

Careers resource

# National Women in Engineering Day

Use National Women in Engineering Day on 23 June to highlight the contribution of women to engineering.

The Women in Engineering Society (WES) has created a downloadable resource pack designed to help you organise activities. WES, in partnership with the *Daily Telegraph*, will also mark the day by publishing the “Top 50 Women in Engineering”, as voted for by the public.

For a talk on engineering careers you could also use the latest Tomorrow’s Engineers resource: *Make a Difference – Be an Engineer*. This presentation is designed to challenge stereotypical views



Advances in engineering have revolutionised medicine.

of engineering and illustrate how engineers improve lives and tackle problems around

the world. Or, to facilitate a discussion around stereotypes in science and engineering, and to help your students to challenge gender myths you could use the Institute’s workshop: *Science: It’s a people thing*.

**For more information:** download the *Science: It’s a people thing* workshop via [iop.org/girlsinphysics](http://iop.org/girlsinphysics). The new Tomorrow’s Engineers presentation is available at [tomorrowseengineers.org.uk/makeadifference](http://tomorrowseengineers.org.uk/makeadifference). Visit [nwed.org.uk](http://nwed.org.uk) for information about National Women in Engineering Day and use #NWED2016.

CPD

# SPN Wales: Ilwyddiant!

The Stimulating Physics Network (SPN) in Wales has quadrupled in size this year and has been granted funding to continue supporting science teachers in schools until March 2017. This means it is seeking new partner schools that are looking to benefit from free, bespoke physics CPD.

Kevin Oakland, deputy head of science at participating school Ysgol Clywedog in Wrexham, said: "It gave me the opportunity to put a new slant on teaching physics, particularly the modelling of circuits, and the sessions that were provided by the TLCs [teaching and learning coaches] gave our students a chance to see physics being used in the real world. I also know that the work TLCs have done with non-specialist teachers has been much appreciated."

Following the success of SPN in England, SPN Wales began as a pilot project in 12 schools for the academic year 2014/15, receiving £25,000 in funding from the Department for Education and Skills (DfES) Wales. For the current academic year the funding increased to £160,000 and the number of schools involved expanded to 48



– including several Welsh medium, bilingual and English schools, and many schools categorised as needing extra support to improve their performance.

Now the support will continue beyond this academic year until March 2017, with an injection of a further £82,000 from the DfES Wales.

**For more information:** if your school would benefit from working with SPN Wales, visit [stimulatingphysics.org/wales](http://stimulatingphysics.org/wales).

## Girls in physics

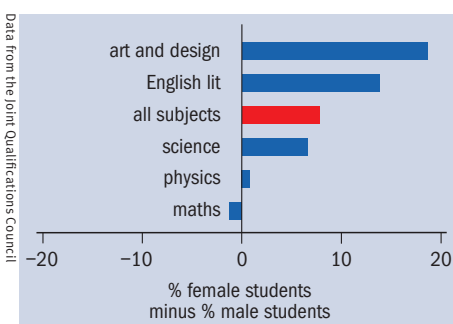
# What drives student choice?

We know that girls outperform boys at GCSE in most subjects, including physics. So why do so few progress to A-level physics?

Cambridge Assessment's Tom Benton looked into the attainment gap at GCSE and found that it is smallest in physics and much greater in subjects like art and English. His research shows that physics is unlikely to be in girls' top-four grades, so they are less likely to choose it as they feel they do better in other subjects.

Delivering a presentation at our Improving Gender Balance conference in February, he stressed the importance of explaining where different subjects can lead when discussing options. Physics develops reasoning skills and has a wide range of careers available, which may not be immediately obvious to students.

Another thought-provoking session examined attitude versus aptitude as a basis for attainment. Sherria Hoskins, a psychologist specialising in teaching and learning at the University of Portsmouth, explained that students with a fixed view about their abilities in physics are less likely to try new things and hence succeed. By supporting your students to feel that their



The graph shows the difference between the percentage of female and male students attaining A\*–C grades. A positive number indicates more females than males attained A\*–C.

ability is something that can be developed rather than a fixed quantity, they are more likely to be resilient and to flourish. This is particularly applicable to girls, who generally suffer from lower self-confidence in physics.

Around 50 teachers and project officers shared their results and their experiences at the event.

**For more information:** resources and presentations from the conference are at [bit.ly/IGBconf2016](http://bit.ly/IGBconf2016).



## Light and electromagnetic waves

Refresh your memory on the main concepts around electromagnetism and light at SPN's upcoming CPD session on 29 June at Carmell College in Darlington. We'll be covering how we see things, how pinhole cameras work, lenses, images, reflection and refraction. We'll also be discussing how electromagnetic waves can be considered as a continuous spectrum. To book, and for more events like these, visit [bit.ly/spn-northeastevents](http://bit.ly/spn-northeastevents).

## Synchrotron simulations

The term's digital highlight is the simulations from the Diamond Light Source, the UK's national synchrotron science facility. Enrich students' understanding of key physics principles with free-to-use, downloadable simulations inspired by this state-of-the-art particle accelerator. Principles include electromagnetism, energy calculations and the Doppler effect. Simulations, resources and worksheets at [bit.ly/dlightsims](http://bit.ly/dlightsims).

## Activities in spring across the regions

- Upwards of 50 teachers came to SPN's South East regional day in Highgate. Read about it at [bit.ly/SPNhighgate](http://bit.ly/SPNhighgate).
- Cowley International College in St Helens is our latest Partner School.
- Physics Network Coordinator Geoffrey Heywood ran a Rockets Make and Take workshop at Dene Community School for teachers in the North East.
- TLC Christina Astin ran an A-level practicals CPD session in Canterbury for early-career teachers in the South East.
- TLC Neil Atkin ran a CPD session on Energy and GCSE Practical for teachers in the South West at SPN link school Thornden School.



## Community

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



# Events

## EVENTS FOR TEACHERS

### GCSE Physics: Light

West Kirby Grammar School, Wirral

22 June

An SPN session to explore light topics at Key Stage 4. Details and booking: [bit.ly/GCSElight](http://bit.ly/GCSElight).

### AstroReach Meet

The Royal Astronomical Society, London

22 June

A free networking day for anyone in astronomy or geophysics outreach in the UK and Ireland. Innovation showcases, a teacher's panel and a National Autistic Society workshop on how to make your events autism friendly. Details and booking: [bit.ly/Astroreach](http://bit.ly/Astroreach).

### South West SPN Annual Physics Day

St Luke's Campus, University of Exeter

24 June

This popular, free CPD day features a mix of practical workshops, talks and congenial networking. All teachers of physics, technicians and trainees are welcome. Details and booking: [bit.ly/SPNPhysicsDay](http://bit.ly/SPNPhysicsDay).

### Teaching KS3 Energy with Confidence

George Spencer Academy, Nottingham

29 June

This workshop is designed for newly qualified teachers of physics or non-physicists who want to build their confidence in teaching Key Stage 3 energy topics. Details and booking: email [suzanne.woolhouse@iop.org](mailto:suzanne.woolhouse@iop.org).

### Misconceptions at KS3: Space Physics

Burlington Danes Academy, London

29 June

Using demos and other resources to explore and develop teaching methods to resolve misconceptions at Key Stage 3. There will also be opportunities to discuss progression to Key Stage 4. Details and booking: [bit.ly/SPNSouthEast](http://bit.ly/SPNSouthEast).

### A Day For Everyone Teaching Physics

The Sjøvoll Centre, Durham

30 June

An SPN day of lectures, updates, workshops, manufacturers, publishers and more; includes sessions for those who are new to the subject, as well as experienced teachers. Details and booking: [bit.ly/SPNdurham](http://bit.ly/SPNdurham).

### Engaging Physics

Simon Langton Girls' Grammar School, Canterbury

1 July

This workshop will explore the means by which you can make physics engaging using toys, *Marvin and Milo* cartoons and other IOP engagement activities. Details and booking: email [jgaisford@langton.kent.sch.uk](mailto:jgaisford@langton.kent.sch.uk).

### Summer School

Charterhouse School, Surrey

4–8 July

A free week-long residential course aimed at boosting physics and chemistry knowledge. Experienced teachers, university lecturers and guest presenters deliver talks and supervised lab work covering the basics of Key Stage 3 and 4. Details and booking: email Katherine Wilkinson [science@charterhouse.org.uk](mailto:science@charterhouse.org.uk).

### Astronomy: KS3 Earth in Space and KS4 Cosmology

St Marylebone CE School, London

6 July

A free workshop aimed at supporting non-specialists teaching astronomy. The day will include a series of practical activities as well as covering the move from Key Stage 3 to 4. Details and booking: email Emma Curties [e.curties@stmaryleboneschool.com](mailto:e.curties@stmaryleboneschool.com).

### IOP Physics Big Day Out

RAF Cosford Museum, TF11 8UP

7 July

Free event focusing on teaching about gravity and gravitational waves. Plus quick ideas to use in class with a focus on the new GCSE practicals. For details and booking: email Tom Dawson [physicsiseasy@googlemail.com](mailto:physicsiseasy@googlemail.com).

### A-Level Teachers' Workshop in Electronics, Computing and Physics

University of Southampton

1–2 August

Spend two days in the labs, working with leading academics and finding out about teaching and research in a world-leading faculty. This free event includes hands-on activities and materials to use in your teaching, and can help build links for widening participation in STEM subjects. Details and booking: [workshop.soton.ac.uk](http://workshop.soton.ac.uk).

## EVENTS FOR STUDENTS

### STFC Particle Physics Masterclasses

Various locations and dates

These events consist of a mixture of talks and practical sessions centred on particle physics. This is a popular event, so please book early to avoid disappointment. Details and booking: visit [bit.ly/Partphysics](http://bit.ly/Partphysics).

### Royal Institution Engineering Masterclasses

Various locations and dates

The Engineering Masterclasses introduce young people to engineering, allowing them to gain insight into its creativity, practice and relevance. A Masterclass series typically contains six Saturday morning sessions. Details: visit [bit.ly/1SexhTE](http://bit.ly/1SexhTE).

### Year 10 Career Conference

National Space Centre, Leicester

20 June and 4 July

These events aim to raise the profile of the space sector and show the diversity of careers, both academic and vocational, available within the industry and to encourage students to study STEM subjects at Key Stage 5. Details and booking: email [nsa@spacecentre.co.uk](mailto:nsa@spacecentre.co.uk).

### The Big Bang London

Various locations across London

July

Free events for students aged 11–18. Details and booking: [bit.ly/BigBangFairLondon](http://bit.ly/BigBangFairLondon).

## Worksheet: notes and answers

Students may ask what the “m” stands for in lead-207m and technetium-99m. Remind them that the element itself is unchanged in a gamma-decay. The “m” stands for metastable, indicating an unstable version of a gamma-emitting nuclide (i.e. lead-207m is unstable and lead-207 is stable).

### Question 1

(a) Alpha cannot pass through body OR

alpha will increase patient dose without contributing to image.

(b) Thallium-201.

(c) For the first mark, they should provide one reason why half-life should not be longer than several hours, e.g. “keep patient exposure low” OR “so that patient does not remain radioactive when they return home”. For the second mark they should give one reason why half-life should not be shorter than several hours, e.g. “radiotracer needs to be prepared” OR “takes time to travel to organ” OR “needs to last long enough to build image”.

### Question 2

(a) Time taken for a number of unstable nuclei to halve (or equivalent statement for count-rate/activity).

(b) Any evidence of attempted half-life calculation gains the first mark. Correct answers gain second mark: 15 MBq.

### Question 3

(a) An electron.

(b) 57 neutrons.

(c) Number 43 added correctly.



# Radioactivity in medicine

**1. Gamma-emitting radioactive isotopes are used by doctors to check whether a patient's heart is working properly. They are injected into the patient's bloodstream and once they have travelled to the heart an image is produced using a gamma camera outside the patient's body.**

**(a)** Why are alpha-emitting radioactive isotopes not used? [1 mark]

.....

**(b)** Which of the following do you think would be most suitable for use as a radiotracer? [1 mark]

Isotope	Half-life
Carbon-14	5730 years
Cobalt- 57	271 days
Thallium-201	73 hours
Lead-207m	0.8 seconds

**(c)** Explain your answer to part (b). [2 marks]

.....

.....

**2. Technetium-99m is a radioactive tracer with a half-life of 6 hours.**

**(a)** What is meant by half-life? [1 mark]

.....

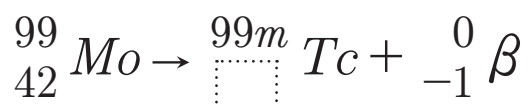
**(b)** A sample of Technetium-99m is prepared. Its initial activity is 240 MBq. What will the activity be after 24 hours? [2 marks]

.....

.....

**3. Technetium-99m is produced from the radioactive decay of molybdenum (Mo).**

**A beta particle ( $\beta$ ) is emitted in the process.**



**(a)** What is a beta particle? [1 mark]

.....

**(b)** In the equation above, how many neutrons does the molybdenum isotope have? [1 mark]

.....

**(c)** Complete the above equation by adding in the missing number for technetium. [1 mark]

Teachers: see page 6 for notes.

[total 10 marks]

# Sweet simulations of radioactivity

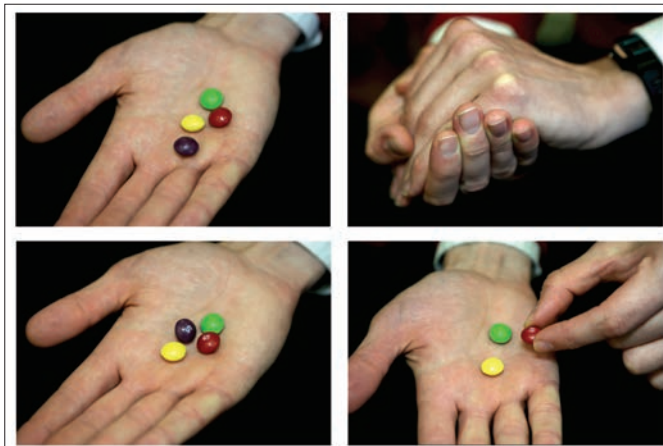


Figure 1. Sweets that have “decayed” (i.e. they landed logo-side up) should be removed after each shake.



Figure 2. To make a visual display of the class results, use a new measuring cylinder to collect “decayed” sweets from each shake.

In this class activity, students model the decay of unstable nuclei using sweets. The analogy illustrates the characteristic shape of decay curves and the random nature of radioactivity.

### Resources required

- One to four sweets per student with a logo or mark on one side (Skittles, which have an “S” on one side, are ideal).

### Optional

- Identical measuring cylinders. The capacity of each must be sufficient so that when nearly full they can hold half the total number of sweets for the class. For example, if you distribute a total of 80 Skittles to your class, seven identical 50 ml measuring cylinders work well.


### Procedure

1. Each student has a number of sweets. This could be between one and four. They hold them in their cupped hands.
2. On your instruction “Shake!”, the students shake their sweets for at least 5 seconds, ensuring the sweets are moving around inside their cupped hands. On the instruction “Stop!”, they stop shaking and open their hands with one hand flat and facing upwards so that they can see their sweets.
3. If any sweets are logo-side up, the students take them out of their palm and dispose of them, probably by eating them.
4. On your instruction “Show”, they put up the number of fingers corresponding to the number of sweets they took out of their palm.
5. Record the total number of “decayed” sweets for the class on the board.
6. The students keep the remaining sweets in their hands and repeat from step 2. If you can arrange that you take a reading once every minute, then you can record the readings against time.
7. Analyse the results by plotting a graph.


### Teaching notes

- The more sweets each student has, the better the analogy of radioactive decay. You could use as few as one per student to keep it simple. Any more than four is quite difficult to manage.
- You may want to appoint a counter and a scribe to count/collect the sweets and record the results.
- Take care with how you ask students to signal the numbers. They may be tempted to add their own (rude) gestures.
- Use the activity to explain why the decay curves trend downwards. Only sweets that are left can “decay”. As there are fewer of them each time, fewer will decay each roll.
- To help your students visualise the data you may want to instruct your class not to eat the “decayed” sweets, but instead dispose of them into measuring cylinders (see figure 2).

**For more information:** videos and animations to support teaching radioactivity are available at [iop.org/radioactivity](http://iop.org/radioactivity). Resources for linking radioactivity to medical physics are available at [iop.org/medical](http://iop.org/medical). This teaching tip was adapted from *Simple Model of Exponential Decay* on our [practicalphysics.org](http://practicalphysics.org) website. With thanks to Helen Rafferty and Rachel Hartley for their assistance.



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