Joining the Institute

Once you gain Qualified Teacher Status we encourage you to join the Institute in the following ways:

- If you have a degree in the physical sciences or engineering, you can apply to become an Associate Member of the Institute or, if you have an interest in but no formal background in physics, you can become an Affiliate Member. Both will give you access to IOP member benefits, such as publications, career advice, regional networks and discounted rates at meetings.
- If you are interested in subscribing to Physics World, join up as an IOP member.

For more details about joining the Institute, visit iop.org/membership.

The Institute also offers an affiliation scheme for schools and colleges. This entitles them to receive: Classroom Physics, Physics Education, Physics World, discounts on conferences and events, free resources and lots more. Contact affiliation@iop.org.

The Institute of Physics is a leading scientific society. We are a charitable organisation with a worldwide membership of more than 50,000, working together to advance physics education, research and application. We engage with policymakers and the general public to develop awareness and understanding of the value of physics and, through IOP Publishing, we are world leaders in professional scientific communications.

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The Institute of Physics is grateful to the Gatsby Charitable Foundation for its generous support of the Learning to Teach Physics programme.

The Kitemark is a symbol of certification by BSI and has been awarded to the Institute of Physics for exceptional practice in environmental management systems.
Certificate number: EMS 573735
Dear new teacher

Congratulations on completing your training. We are delighted to welcome you into the physics community. We value all teachers of physics (even if physics is not your specialism) for two important reasons:

Firstly, you will be doing physics simply by discussing physics with your students. You will be showing them what it is like to think like a physicist, helping them to see the world in a physics way and — above all — demonstrating the beauty of a physics explanation!

Secondly, as a classroom teacher, you will be the single biggest influence on the physics future of your students. So you are directly improving the health and prospects of physics in the UK, Ireland and globally.

For these reasons, we believe it is essential that teachers of physics are offered the support and the resources you need throughout your career. This booklet describes just some of our activities and opportunities for you to get involved.

We’re looking forward to working with you!

Charles Tracy
Head of Education
Institute of Physics

Teaching physics is doing physics

Learning to teach physics

IOP support for NQTs

We have a range of cost-free support for all teachers who are learning to teach physics.

LTP supports early-career teachers of physics whatever your specialism. All trainee science teachers who sign up for IOP Student Teacher Affiliation automatically become part of the LTP programme. You will receive e-newsletters, resources and invitations to events. You can sign up online at iop.org/student-teacher.

Our network of more than 50 experienced physics teachers offers free CPD, support and advice to teachers of physics. Spanning the UK and Ireland, they organise and co-ordinate local CPD events and build links between school sectors, and between schools and universities.

Follow @TakeOnPhysics to build your own teacher network and connect with the wider physics community.

TalkPhysics is our online learning community for teachers of physics and their supporters. It’s a safe space to ask questions, share ideas and access teaching resources. Sign up for our brand new schedule of physics teaching webinars. Join almost 10,000 others at talkphysics.org.

Our Twitter feed is ideal for new teachers of physics. We use it to share ideas, events and resources: from the best physics apps to raising awareness of policy issues and CPD around the UK and Ireland.

Make sure that your NQT school is affiliated to IOP. We currently have more than 1700 affiliate schools and colleges. They receive our teaching newsletter Classroom Physics, all of the latest IOP teaching resources, invitations and discounts to our teaching events and conferences, access to our journal Physics Education, input into our education forum and other benefits.

School Affiliation

A government-funded project to improve the teaching and learning of physics in England. Regional workshops are open to all science teachers whatever their specialism, plus we offer partner schools bespoke support such as expert coaching, careers activities, residential courses and pupil support. Find out more at stimulatingphysics.org.
Who gets to do this every day at work?

Like every NQT, Adrian’s first year teaching physics involved many hours preparing lessons and learning to manage his classroom.

Who gets to do this every day at work?

Here are some of his highlights:

- Melting chocolate in a microwave to calculate the speed of light
- Getting a chatty student to walk to the end of the corridor then telling them they are still not far enough away to represent an electron’s distance from the nucleus
- Rubbing balloons on each other and then using the static charge to stick them on the wall or pick up sugar
- Fishing for paperclip fish with magnets then electromagnets to see who can get the most
- Blasting a long-haired student with an airzooka all the way down the corridor
- Radiowave: body wave from left to right hand and back again
- Microwave: twisting the knob on a dryer set to cold maximum flow
- Infrared: shivering
- Visible: hands make a telescope
- Ultraviolet: slip, slap slop as they de-egg-cellerate
- Gamma: hands round the throat

How does IOP help you?

The Learning to Teach Physics e-mails are a useful reminder of what’s available and a reminder of where things are good. I tend to visit www.iop.org when I need resources or lesson ideas. Since our SoWs are all relatively new, I go online when I need practicals to explain certain concepts.

Thoughts from recent NQTs

Halfway through their induction year, we asked a group of science NQTs how they were finding their first year of teaching physics. Here are some of the responses.

Best aspects?

- Being free of all of the paperwork that was involved during my PGCE.
- Having my own room, making my own decisions as to how I teach my own groups.
- One observation per half term is manageable, much better form of feedback.

How you view of teaching changed?

I’ve realised it’s not about the work, it’s about relationships. I work in an inner-city school and if you don’t take the time to build up the relationships, the learning doesn’t follow.

How some pupils speak to teachers:

- I only experienced high set classes in placements, so seeing how some of the bottom set classes behave is a surprise.
- How tired I am. I thought the PGCE was hard enough!
- I’ve had to realise it’s OK if we don’t meet all of the learning objectives because they can be picked up on in the next lesson.
- I’m more aware that teachers don’t necessarily have much more knowledge on a topic than the pupils, but can still use that knowledge to produce outstanding lessons.

What has surprised you most?

The state of my school’s science department – definitely not transparent at interview!

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The to-do list is never finished but everyone is in the same situation. How tired I am. I thought the PGCE was hard enough!

And lesson planning...?

I tend to design my own lessons rather than spending hours scouring others, but I use existing worksheets and rarely make my own.

I can now plan a 100 min lesson in less than 30 mins, which I’m very happy with!

We have brought in schemes of work (SoW) which I adapt and take ideas from. Each lesson is my own twist on existing ideas.

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Teaching resources

Finding your own materials can be a minefield. Fortunately, IOP has everything you need to teach physics at secondary level.

Supporting Physics Teaching (SPT)
Teaching physics presents unexpected challenges to both specialist and nonspecialist teachers. The SPT materials have been developed for all new teachers of physics, boosting subject knowledge, highlighting common problem areas for pupils and offering teaching strategies. Explore SPT online at supportingphysicsteaching.net.

Teaching Advanced Physics (TAP)
TAP offers a comprehensive set of detailed resources to help you to plan lessons for 16–19 year olds. The resources are aimed at those who are new to teaching this age group, and don’t assume that you have lots of equipment or advice from experienced colleagues. Adapt the resources to work for you. Download TAP (Word documents) at tap.iop.org.

Gender Balance
For more than 25 years, only a fifth of students progressing on to A-level physics have been girls, despite similar success between the genders at GCSE. We have research and resources to help you become more gender aware in your teaching, so as to fully engage all your students and help them to see what physics can offer. iop.org/genderbalance.

IOP Education Resources
These sets of videos and computer animations support teachers who are new to teaching these subjects at 11–16. They are available on our website at iop.org/teachingradioactivity iop.org/teachingspace teachingmedicalphysics.org.uk or on DVD by getting in touch at education@iop.org.

Classroom Physics
If your school is affiliated with IOP, it will receive Classroom Physics, the Institute’s newsletter for teachers. It will keep you informed of meetings, INSET courses, resources and other support that the Institute and other organisations offer to all teachers of physics. It also includes some starter ideas, teaching tips and worksheets, particularly for 11–16-year-old students. You can find it online at iop.org/classroomphysics.

Physics Education
Physics Education is the Institute’s international journal on research into physics pedagogy. It contains informal articles about the teaching of physics, news, teaching tips and reviews of textbooks and software. It’s a great way to keep up with the latest ideas in teaching physics and to keep your teaching fresh. Affiliated schools have free access to the online archive. iopscience.org/ped.

IOP.org/education/teacher/resources
This article summarises a discussion on the assessment process while ensuring your students engage with excellent ways to get your marking done.

Marking is one of the major pressures on all teachers’ time. It can seem like it is eating too much of your time, both inside and outside school. But there are a few tricks from the physics-teaching community that you may find useful.

**Tackling the marking mountain**

Marking that is one of the most powerful ways a teacher influences their students’ learning. There are no shortcuts as each student will have different needs, but if you are going to send time marking I recommend this approach where possible.

### Think about why you’re setting the homework

A lot of homework is set with no particular purpose other than to generate a mark and that usually means teacher marking. It’s worth asking the question — what is the purpose of homework? I imagine that most enlightened senior leadership teams would like teachers to spend time planning and would be dismayed if the marking load was getting in the way.

Research evidence shows that Assessment for Learning — giving feedback that focuses on what a pupil can do to improve – is one of the most powerful ways a teacher can be enlightened senior leadership teams would like teachers to spend time planning and would be dismayed if the marking load was getting in the way.

### Set homework that is efficient and effective

As an NQT, I advise you to prioritise planning lesson content and developing your teaching skills over marking. Only then can you start thinking about homework.

When that is in place, think about tests. And only when all that is working well can you realistically start working on how to get each individual student’s achievement levels up. Physics has many mathematical elements, which can be easier to mark, so homework designed to test understanding does not need to be marking intensive. Filling in the blanks, solving problems and questions requiring short answers can test a wide range of topics and pick up where they are struggling.

### Think like a physicist

I often find myself saying the same things over and over again — underline headings, put units in, results table headings, etc. So I wrote a list of all the things that crop up and put them onto a PowerPoint loop. When marking the reports, I just annotate them using a code e.g. M2 is method point 2. G4 is graphs point 4 and so on. On receiving the books, the pupils have to write out the points in full as targets for the next time they write a report. I find they take the comments more seriously if they’ve written them out themselves.

To read more about marking — and to find some marking coding schemes — join the TalkPhysics discussion “Making marking less of a mountain” at talkphysics.org.

### Fault-finding in simple electric circuits

Building simple electric circuits should be easy. But in practice, however well you and your lab technician have prepared, you’re going to need to get good at trouble-shooting your students’ attempts, says Alan Baugh, IOP Teaching and Learning Coach.

Fault-finding in simple electric circuits

**First and foremost, resist the temptation to start replacing components immediately.** Look at what you have in front of you — a visual inspection may throw up obvious problems.

If you find circuits daunting, use our checklist below to help develop your fault-finding skills. Take it slowly, think logically and you’ll find you can soon get those circuits working every time.

#### Checklist

1. **If it’s a complete bird’s nest of wiring, don’t even go there.** Get the students to start again without using voltmeters. Then add voltmeters after the circuit is otherwise working properly.
2. **Look for common mistakes such as:**
   - incomplete circuit
   - reversed polarity components
   - a/c supply instead of d/c
   - apparently identical lamps with different current or voltage ratings
   - “Flat” batteries
   - “Flat” internal batteries (e.g. on digital meters)
3. **Verify that the power source (battery or lab pack) is producing the potential difference expected by using either a voltmeter or multimeter.**
4. **Use a voltmeter to check that the potential difference across individual components of the circuit is reasonable.** There should be no p.d. across the connecting leads and contacts.
5. **If you still haven’t been able to identify the source of the problem, now is the time to try swapping potentially faulty components.** Remember to do this one at a time!
6. **Another approach that some teachers find works is to draw the circuit out on large pieces of paper and get the students to build their circuits over this “map”.**

#### Other common problems

- “Flat” batteries
- Apparently identical lamps with different current or voltage ratings
- Connecting leads with internal breaks
- Loose or corroded connections
- Faulty ammeter shunts, voltmeter multipliers and “flat” internal batteries
- Finally, the most common problem of all: students. Sorry, but you can’t replace these.

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**TalkPhysics**

This article came from a workshop at a Stimulating Physics CPD day open to all local science teachers.
Get your pupils talking in physics lessons

This may seem strange advice when others talk about class control. But it is essential to recognise the extent to which subject-specific vocabulary and technical terms are an essential part of the physics curriculum, says Phil Badley, a Stimulating Physics Network Teaching and Learning Coach.

I have heard it said that pupils come across as many new words in KS3 science as they do in a modern foreign language. Pupils must be able to recognise the words, know their scientific meaning and be able to use them in appropriate scientific contexts.

This is particularly important in physics, where there are a lot of specialist words that are used in everyday talk. For example, power, work, resistance and energy all have very specific meanings for a physicist.

The development of appropriate literacy skills will take time and talk is an important element of the process. Use structured activities to encourage pupils to talk to each other about the physics they are learning.

Initial activities could involve identifying appropriate terms, sharing information from a comprehension or working together to match appropriate pieces of information. More advanced activities will involve discussion, role play, preparations for presentation and the analysis of information. Make sure that group tasks are sufficiently challenging to require group co-operation.

Activity ideas

1. Identify groups of words/terms from a list and explain reasons for groupings.
2. Match appropriate cards showing terms, definitions, units, etc.
3. Give each group three different sheets of information about a famous scientist plus a series of statements about a topic that may be correct, inaccurate or just interesting. Groups discuss and then feedback their ideas.
4. Talking Points – a list of 10 questions that can only be answered by sharing information.

Finally, a warning from bitter experience

Pupils who have been sitting quietly and passively in classroom-based lessons all day may need extra management when doing these activities. The buzz of a room full of pupils talking about physics will make it all worthwhile!

Whatever the activity, don’t assume pupils will already know how to organise themselves or how to tackle the task. Plan the activity carefully:

- control the groupings with allocated roles to suit the task
- give clear expectations and explicit outcomes
- demonstrate and scaffold the appropriate skills
- hold a plenary/debriefing to support learning about the content and the process.

Teaching energy

When students come to your lessons, they already have a strong idea of what energy is from everyday language. You, as a scientist, will have a more technical understanding. So, asks Jon Clarke, IOP Learning and Teaching Coach, what could possibly go wrong when you teach the energy topics in physics?

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Many teachers starting out are surprised at the challenges they encounter when preparing lessons on energy. You will not be alone – the teaching of energy ideas has been debated for at least the last 50 years. So here are a few things to keep in mind.

In physics, energy is very much a book-keeping tool. Analysing energy in a system is useful because we know that it is conserved. So we know the total amount of energy and can work out things like “How much fossil fuel do we need to burn to supply my electricity for a day?” or “How many chocolate bars do I need to eat to climb this mountain?”

Using energy to describe a situation can make something sound scientific. But very often, it doesn’t explain anything.

Try excluding the word energy from your explanations and the processes underlying them become much clearer.

You may find it useful to think about energy being transferred between different energy stores during a process rather than it being converted from one form to another.

Find out more in the Supporting Physics Teaching Energy topic supportingphysicsteaching.net/EnHome.html.

For blogs about teaching energy visit talkphysics.org/groups/energy-in-the-new-curriculum.

Further thoughts at: nuffieldfoundation.org/practical-physics/helpful-language-energy-talk.

Example

Imagine a simple demonstration where you drop a set of keys and ask about the physics of the situation. Older students may want to tell you the keys have gravitational potential energy. But what does this actually tell you?

“The keys’ weight pulls them to the ground, where they make a noise.” All of this is valid, relevant physics and explains the situation well without any mention of energy. It’s only when we ask questions like, “How fast are they moving just before they hit the ground?” that it becomes useful to talk about shifting energy from the gravitational store associated with the keys, into their kinetic store. The only valuable reason to bring energy into the discussion is to answer a question that involves a calculation.