Future proofing
Soft skills, hard skills and work experience
Hello and welcome to the October 2022 Physics World Graduate Careers section

At any stage of your degree, it’s always a good idea to be thinking of ways to grow beyond the classroom, and develop the hard and soft skills that future employers are looking for.

As Carol Davenport – associate professor at Northumbria University, UK, and director of NUSTEM – explains, it’s often much easier to list academic achievements than it is to accurately build and describe soft skills, such as time management and public speaking, that are as essential as your technical prowess when it comes to the workplace. In her article “16 key skills and attributes for a successful career in physics” she focuses on which skills you may need, and how to highlight them to a potential employer.

A good way of developing such skills is to take on work placements and internships throughout the course of your studies. Not only is this a good way of seeing if a particular field of study is really to your liking, finding a placement in a big lab may open your eyes to career routes you didn’t know were even available to you, as Annabelle Gill describes in her article “A school student’s week at CERN”.

Making decisions about your career can be an exciting process, but for most people it’s also a tricky one. It can be hard enough to find out what jobs actually exist, let alone whether they would be a good match for your skills and interests, but you can always look to the Physics World Careers pages, to explore the breadth of careers open to you with a background in physics.

Also, don’t forget that our free-to-read Physics World Careers guide is always available, offering you careers advice, insightful case studies showcasing possible career options, plus a comprehensive employer directory. And jobseekers with a background in science, technology, engineering or mathematics can explore all the latest opportunities on Physics World Jobs, a recruitment website from the publishers of Physics World.
Applying for a job, a placement or an internship can be a challenging and stressful task. Even if you’re successful, you’ll still have to face an interview, where a potential employer will hope to quickly appraise your talents and abilities. Of course, your technical prowess is indispensable, but you’ll need much more than scientific knowledge to secure the position.

That’s because today’s employers are looking for a host of additional skills to determine how you will fit into their workplace. From being able to manage your time and sort out conflict to knowing how to communicate, these so-called “soft skills” are as important as your subject-specific knowledge that you developed during your degree.

The “hard” skills you gained while studying – whether it’s knowing how to solve a differential equation or line up mirrors on an optics bench – are easy to provide evidence for, from the modules you took or the lab work you did. But the other more nuanced and practical skills – such as presenting in front of your peers, writing reports or keeping to deadlines – are just as crucial. After all, they show how you work with others, how you communicate and how you organize yourself.

Developing and understanding how your practical experiences have already led you to build these skills is an important step in your career planning and job hunting. Despite being categorized as “hard” or “soft”, both of these skill sets are invaluable when it comes to your employability. If you’ve worked part-time in the hospitality industry, for example, and had to communicate effectively with an irate customer, you’ll know that it definitely isn’t easy to use soft skills.

And just in case you don’t believe that soft skills are really that important for a career in physics, just look at a recent job advert for an applied laser physicist at the UK defence company AWE that I spotted on Physics World Jobs. The company said it was looking for candidates to have the following attributes, where the first three are hard skills and the last two are soft skills:

● A degree in physics
● Some experience of working with lasers or optics in an undergraduate laboratory setting would be advantageous
● Experience conducting empirical scientific research and drawing sound conclusions
● Ability to plan and manage the delivery of own work
● Ability to work as part of a team with a range of stakeholders

As a former physics teacher and now director of NUSTEM, an outreach and research group at Northumbria University in the UK, I regularly help schools showcase careers in science, technology, engineering and mathematics (STEM) subjects to young people. We often talk about soft skills that people who work in STEM require. And as a recent student or graduate, you should think about which of these skills you may already have developed.

You should think about which of these skills you may already have developed...
analysis identified 19 attributes in total: 13 are soft skills, four are hard skills and two are a combination of both.

These attributes are ones that STEM professionals think help make them successful in their jobs, which brings us back to job applications. Imagine you’ve applied for the laser physicist role mentioned earlier and got an interview. You may be asked something like “Can you give me an example of a project or situation where you’ve had to work as part of a team, and how did you contribute to the effectiveness of the team?” Well, if you’ve collaborated on a group project then that shows teamwork, and if you’ve already reflected on those attributes, you’ll be able to answer the question more easily and in detail.

**Case studies**

Recently, I asked two physics undergraduates to look at the original 16 NUSTEM attributes and consider which three they thought they had developed most during their degree so far.

**Bethany Willis** – who has completed a BSc (Hons) in physics at Northumbria University and is about to start a PhD in product-integrated photovoltaics – chose:

- **Committed** A degree is a long-term commitment and parts of it are long, hard, boring or difficult. You need to be motivated and try your hardest to get the best out of your education and you sometimes end up enjoying the things you didn’t previously like.
- **Tenacious** Physics can be complicated at first and being tenacious means you are able to overcome any challenges that come your way. This could be problem-solving or even working on a longer project.
- **Communicator** In physics it is important to share your ideas and inspire others. This is why being a good communicator is important – particularly for tutoring other students or doing outreach and motivational presentations in public.

**Rosie Wainwright** – a 3rd year BSc (Hons) student in physics with astrophysics at Northumbria University – chose different attributes:

- **Passionate** I would say that my passion has developed throughout my degree. As my knowledge has grown, I have enjoyed becoming more enthusiastic to obtain a greater understanding of physics.
- **Logical** I believe I have become more logical because of the work my degree has required so far, and that the evolution of this attribute is helping me with my degree as it progresses. It is now a strong attribute as I find myself better at managing and solving problems in calmer and more successful ways in most aspects of my life. I find this an invaluable skill to have developed.
- **Hard-working** I’ve found hard work is an essential attribute in my degree. Working consistently with maximum effort means that more is achievable and more success can be found. Working hard is enjoyable to me when it is related to what I find interesting. This is why it has thrived within my degree and I like to think working hard is becoming a general attribute of mine.

**Use it to improve it**

The good news is that you can improve such soft skills just as you can get better at analysing data or implementing good health and safety practice. You can identify an attribute you’d like to develop – such as your communication skills – and try to find situations where you could develop it. Perhaps by volunteering to provide verbal feedback during a group task. It doesn’t always have to be during your studies; it could be in your social activities or part-time job.

Have a look at the NUSTEM attributes and reflect on which ones you already have used during your degree, and which ones you could develop. You’ll then have great examples to use in application forms and interviews – and hopefully line up the dream job you’ve been after.

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**Nine attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Examples of terms used by STEM professionals for this attribute</th>
<th>% of STEM professionals with this attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>open-minded</td>
<td>adaptable, embrace change, healthy level of scepticism</td>
<td>48</td>
</tr>
<tr>
<td>communicator</td>
<td>diplomatic, good writer, deliver clear presentations</td>
<td>46</td>
</tr>
<tr>
<td>logical</td>
<td>critical thinker, analytical, can improve processes</td>
<td>37</td>
</tr>
<tr>
<td>domain-specific</td>
<td>numerate, safety conscious, know the subject</td>
<td>35</td>
</tr>
<tr>
<td>knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>curious</td>
<td>ask questions, interest in learning, try new things</td>
<td>33</td>
</tr>
<tr>
<td>creative</td>
<td>innovative, inventive, resourceful</td>
<td>33</td>
</tr>
<tr>
<td>good colleague</td>
<td>fair, friendly, get on with people</td>
<td>32</td>
</tr>
<tr>
<td>resilient</td>
<td>learn from mistakes, don’t give up, problem solver</td>
<td>32</td>
</tr>
<tr>
<td>collaborative</td>
<td>team player, learn from and with others, supportive</td>
<td>30</td>
</tr>
</tbody>
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Adapted from Davenport et al. (2022) FIE 2022 (accepted for publication)

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**The chosen 16** NUSTEM chose 16 skills that are important for those looking to build a career in STEM.

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**Carol Davenport** is an associate professor at Northumbria University, UK, and director of NUSTEM, e-mail carol.davenport@northumbria.ac.uk
In the last week of the summer term, my school – Hayesfield Girls’ School in Bath – asks all year-12 students (aged 16 or 17) to undertake a week of work experience. I was really lucky to get the chance to do my work experience at CERN, the particle-physics laboratory near Geneva, Switzerland, which houses the Large Hadron Collider (LHC). Much to my delight, my week was organized by electronics engineer Eva Gousiou, who is part of CERN’s Women in Technology group, so I got to spend time with many female scientists and engineers.

Monday
I started my week with high-energy physicist and University of Pittsburgh research associate Marilena Bandieramonte, who works on the ATLAS experiment, the largest detector at CERN. She initially showed me around the CERN visitor centre, which gives a great introduction to the overall purpose of the research at CERN.

In the afternoon, she described her work to me, which includes creating simulations for the ATLAS detector. She explained how her models can be employed by the ATLAS users to simulate their detector experiments and predict the likely outcomes.

Tuesday
The next day, I continued shadowing Bandieramonte, as she worked on improving the user interface for the ATLAS simulations, and I had the chance to visit the ATLAS control room. This was an exciting opportunity – while I had visited CERN previously on a guided tour, I’d only been able to see the control room from outside. But this time I was allowed to enter the room itself and see exactly what goes on in there.

Massive screens full of data and figures cover all the walls, showing information about the condition of the ATLAS detector. If anything were to go wrong, the researchers in the control room could make necessary adjustments. In the afternoon I attended a weekly ATLAS debrief, which included a general status update where they noted that the previous week the LHC had recorded collisions at its highest ever energy.

Wednesday
My third day’s plan was to meet Sophie Baron, an engineer in the experimental physics department, but this could not go ahead, as she had come down with COVID-19. However, I was able to learn about the group on a Zoom call with her instead.

I later met up with Baron’s colleague Philippa Hazell, who showed me around their laboratories, where they design and test the electronic systems and components used in the various experiments at CERN. She explained that the electronic chips they use could be affected by radiation from the particle collisions. To prevent this, the chips are designed with the digital logic repeated three times – and the majority decision used as the outcome.

Thursday
I spent the penultimate day with electromechanical technician Ellen Milne in the radio-frequency (RF) department, where they generate the signals used to accelerate particles in the RF cavities of the Super Proton Synchrotron (SPS) accelerator. This is the second largest machine at CERN, and it provides the accelerated particle beams for the LHC. I was able to see how they generate the power, including seeing tests done on an 800 MHz radio-frequency klystron.

After this I was driven out to visit the LHCb and CERN Axion Solar Telescope (CAST) experiments. LHCb studies the beauty (bottom) quark, and is looking to find a reason for the differences in the amounts of matter and antimatter within our universe. Meanwhile, CAST is an experiment searching for axions – theorized particles that, should they exist, could be found in the centre of the Sun. They are also a candidate dark-matter particle, and their existence might help in explaining the matter–antimatter discrepancy, by tapping into the weak force.

Friday
On my last morning, I spent time with computer engineer Florentia Protopsalti, who works in the IT department. She took me into the control room for the Data Centre, from which CERN’s entire scientific, admin and computing infrastructure is run. Protopsalti explained that all the data from the experiments are sent there to be sorted. The majority of this information is not scientifically significant, so algorithms are used to decide which data to store and which to discard.

In the afternoon, I had the chance to meet with Eva Gousiou, who had arranged the whole job-shadowing week for me. She took me to see the CERN Control Centre. This is where they monitor and control the accelerators, including the Linear Accelerator 4 (LINAC4), SPS and the LHC, as well as controlling the cryogenics and tunnel access. I got to see lots of the screens displaying information surrounding the condition of the accelerators. Generally, the older the accelerator, the more that has to be done manually from the control room, whereas newer accelerators such as LINAC4 are more automated and require less input.

Overall, I really enjoyed my week at CERN. Everyone was really welcoming and, as well as my hosts, lots of other people offered to show me round their labs and explain things to me. I was particularly surprised by how many people had programming skills and how this was needed for their jobs. It made me think about my future career and the possible job options available at labs like CERN.

Annabelle Gill is a sixth-form student studying A-levels in Bath, UK.
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Before sending an application please get in contact with one of the PI’s of the participating research groups (https://www.quantum.unibas.ch/people). After contacting one of the PI’s and secure their support for your application for a PhD position please submit the following as a single pdf file via email to the coordinator Dr. Thilo Glatzel (thilo.glatzel@unibas.ch) not later than October 10th 2022:

• Curriculum vitae.
• Official transcripts MSc, BSc, diplomas etc with grades, from all relevant institutions of higher education (all in English or German).
• Motivation letter. A short statement of your research interests and how they relate to the work of our department and the specific research group.
• List of publications, if available.
• Reference letters (submit separately).

Further information is available on the PhD program web site: https://www.quantum.unibas.ch/

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Your pathway to a future in nuclear science

Postgraduate training that is personalized, flexible and taught by experts – that is what’s on offer from the Nuclear Technology Education Consortium (NTEC), whose novel courses aim to create the UK’s next generation of nuclear experts, with the skills to secure a sustainable and safe nuclear industry.

“What we offer is a vocational programme, the whole goal of which is to support the nuclear industry,” says Gavin Smith of The University of Manchester. NTEC was formed in 2005 to tackle concerns that not enough students were graduating from UK universities to meet the needs of the nuclear sector, be it in operation, decommissioning or new build. It was set up following detailed consultations with the whole of the UK nuclear sector including businesses, regulators, the Ministry of Defence, the Nuclear Decommissioning Authority, government departments and the Cogent Sector Skills Council.

Seven institutions – the universities of Birmingham, Central Lancashire, Leeds, Liverpool, Manchester and Sheffield, as well as the Nuclear Department, Navy Command – provide 16 different course units that are directly taught. Nine of these are also available in a distance-learning format, with another six units being converted over the next couple of years. Students graduate with an MSc, a postgraduate certificate, a diploma or a continuous professional development (CPD).

Bespoke training
The NTEC courses are distinctive in that they are aimed at both graduates straight out of university and industry professionals seeking to broaden their skills and knowledge. “A unique aspect of our courses is the delivery method,” says Smith, who explains that each course unit is taught in a one week short-format method. “Instead of a student having a course delivered over a one-hour slot every Monday morning at nine o’clock for a full semester, they take eight course units for the full MSc, and study each one for a week at one of the member universities.”

Each course unit includes about 35 hours of direct contact, but totals around 150 hours when including pre- and post-coursework, exams and study time. This approach allows the training to be accessed by people working in industry, who might find it easier to take one week out of a work schedule, rather than attending a full semester of classes. “They can do a part-time course over three years, where they do four modules in year one, four modules in year two and then do their project in year three,” says Smith. “That’s the kind of model we were told by industry that they prefer, rather than having day release or losing an employee for a full year.” The course offers a broad scope of choice and flexibility, with supervisors providing recommendations depending on the interests of each student.

Broad spectrum
NTEC encourages applications from graduates with a wide variety of science and engineering backgrounds, including those with degrees in aerospace, chemical engineering, chemistry, civil engineering, computer science, materials, mechanical engineering and, of course, physics. Applicants straight from university will be required to have at least a 2:2 degree in a relevant discipline.

For applicants with some years’ industrial experience, a lesser qualification may be acceptable. However, each application is considered individually – the main criterion being whether a registering university believes that a potential student has a good chance of completing the programme successfully.

As part of the degree, full-time students also undertake a research project during the summer. “We start thinking about projects around April, and we encourage most full-time students to do the project within industry,” says Smith. “This gives them a flavour of industry and provides a stepping stone between university life and going into industry once they’ve finished their studies.”

Part-time students do their project in their third year, mostly at their own company, which Smith says lets them “contribute to their employer’s goals and research requirements”.

Hands on NTEC student operating the VR-1 Reactor at the Czech Technical University.
Practical experience
One former full-time NTEC student is Saralyn Thomas, who now works in the nuclear industry. “It’s such a fantastic place to work, and it truly is an exciting time to join the industry with increased support from the UK government on various nuclear projects as the world comes to fully appreciate that net zero needs nuclear,” says Jackson. “Pursuing a career in the nuclear industry was the best decision I have ever made – the second best being the NTEC course, which opened those doors for me.”

For Thomas, the course gave her the opportunity to meet other like-minded individuals, some of whom were already working in the nuclear sector. “It also gave me a fantastic insight into what it would be like to work in different areas of the industry,” says Thomas, for whom a summer placement at the National Nuclear Laboratories through NTEC cemented her desire to join the nuclear industry. “If we are to meet our net zero goals with nuclear as a key part of that energy mix, it is critical that we get the right people into the industry so we can fill the skills shortage which we currently face in the sector – and NTEC is just the course you need to equip yourself with those skills.”

Another former full-time NTEC student is Sophie Jackson, who has now worked in the nuclear industry for more than six years. Her job involves ensuring nuclear material is safe and reducing the risks as low as reasonably practicable. Jackson has worked in many areas from fuel enrichment to decommissioning, none of which she says would have been possible without attending the NTEC Masters degree.

“I studied from 2014 to 2015 and can honestly say it was one of the best decisions I have ever made,” says Jackson. “The course prepares you for industry like no other, it is designed by industry for industry professionals and students wanting to kick start a career in nuclear.”

Before finishing the course, she had already been accepted for a job as a nuclear safety engineer at BAE Systems Submarine Ltd, having met the team at its Barrow site organised by NTEC. “You have the chance to meet many nuclear professionals throughout the course which helped me know what area I wanted to work in and allowed me to develop relationships with professionals in the nuclear industry,” she adds.

Students on the NTEC courses also benefit from lectures given by external industrial experts as well as an annual bespoke careers fair. “We invite all the nuclear companies that support the programme, so that students are able to talk to them about projects and possible employment once they complete their studies,” says Smith.

The consortium has an external advisory board, to ensure that the course quality does not drop, and that its content is relevant. As Smith points out: “Ultimately our course was formed on the basis of a big stakeholder consultation, to see what industry wants today and what it needs in the future.”

NTEC courses
For more information on the course and how to apply, visit the NTEC website: www.ntec.ac.uk. Note that all course units will eventually be converted to fully distance learning.

Applications are open from now until the start of the course in September 2023, and most students can apply for funding through a postgraduate master’s loan. Applications for single modules are open year-round – you should submit your request at least four weeks prior to the module taking place.

Entry requirements for the Nuclear Science and Technology MSc, postgraduate diploma and postgraduate certificate are the same. Applicants straight from university are required to have at least a 2:2 degree in a relevant discipline. Part-time UK students are accepted with the lower qualification of a higher national certificate (HNC) as long as they have at least seven years’ work experience in the nuclear industry.

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Careers

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