



Limit Less

Teaching without limits

The need for a whole
school equity approach

IOP Institute of Physics

Secondary schools
in Scotland

Information about the surveys referred to in this document

In 2020, the IOP commissioned Censuswide, an international market research consultancy, to conduct two surveys and a series of focus groups to inform our campaign. The survey was of 3,007 parents and carers of children aged 5–16 in state schools in the UK and Ireland. In 2021, we commissioned Censuswide to conduct a further survey of 2,000 primary and secondary school teachers across the UK and Ireland.

Information about the quotations used in this report

In the preparation of this report, the IOP asked its members to provide their own stories of lived experience related to the stereotypes and barriers that our campaign aims to dismantle. A similar request was made to subscribers to IOP's Qubit newsletter, who are aged 16–19. A series of requests was also posted on IOP's Twitter account, [@physicsnews](https://twitter.com/physicsnews). The IOP is grateful to everyone who has shared their experiences with us and invites anyone reading this report who would like to share their own experiences to please contact us at campaigns@iop.org.

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What is Limit Less? And what are we asking you to do?

To ensure that all young people have the same opportunities, there needs to be a transformation in our schools.

The Institute of Physics (IOP) knows that many young people are put off studying physics after the age of 16, not because of a lack of ability or interest in the subject, but because of prevailing social attitudes that discourage them. There is a widespread misconception that physics is a subject for other people, perhaps people who they think are cleverer, or who come from more privileged backgrounds or particular social and ethnic groups. This leads to many young people deciding that 'physics is not for them'. This view is picked up from all around – be it the education system, from parents and family, and from among local communities and wider society.

This must change. Limit Less is the campaign that aims to encourage and support young people to change the world and fulfil their potential by doing physics. It seeks to challenge the misconceptions and stereotypes about the subject and remove the barriers to young people doing physics beyond the age of 16.

And we need the help of teachers and senior leaders in our schools and colleges to call for this change in our system.

Schools and teachers are important influencers of young people and their parents, and we know that your work is crucial to encourage more young people from underrepresented groups to study physics in school and consider a career using physics. We need your voice to help us challenge the government to make this Limit Less dream a reality.

We are asking that you sign up to support the IOP's manifesto for change which you can read in this report. It outlines how schools and nurseries can be more inclusive across the UK and Ireland. There are ten areas of improvement that can help make physics learning, and all education settings, more inclusive.

We look forward to working together to build a fairer and more inclusive environment in schools for all young people through the Limit Less campaign.

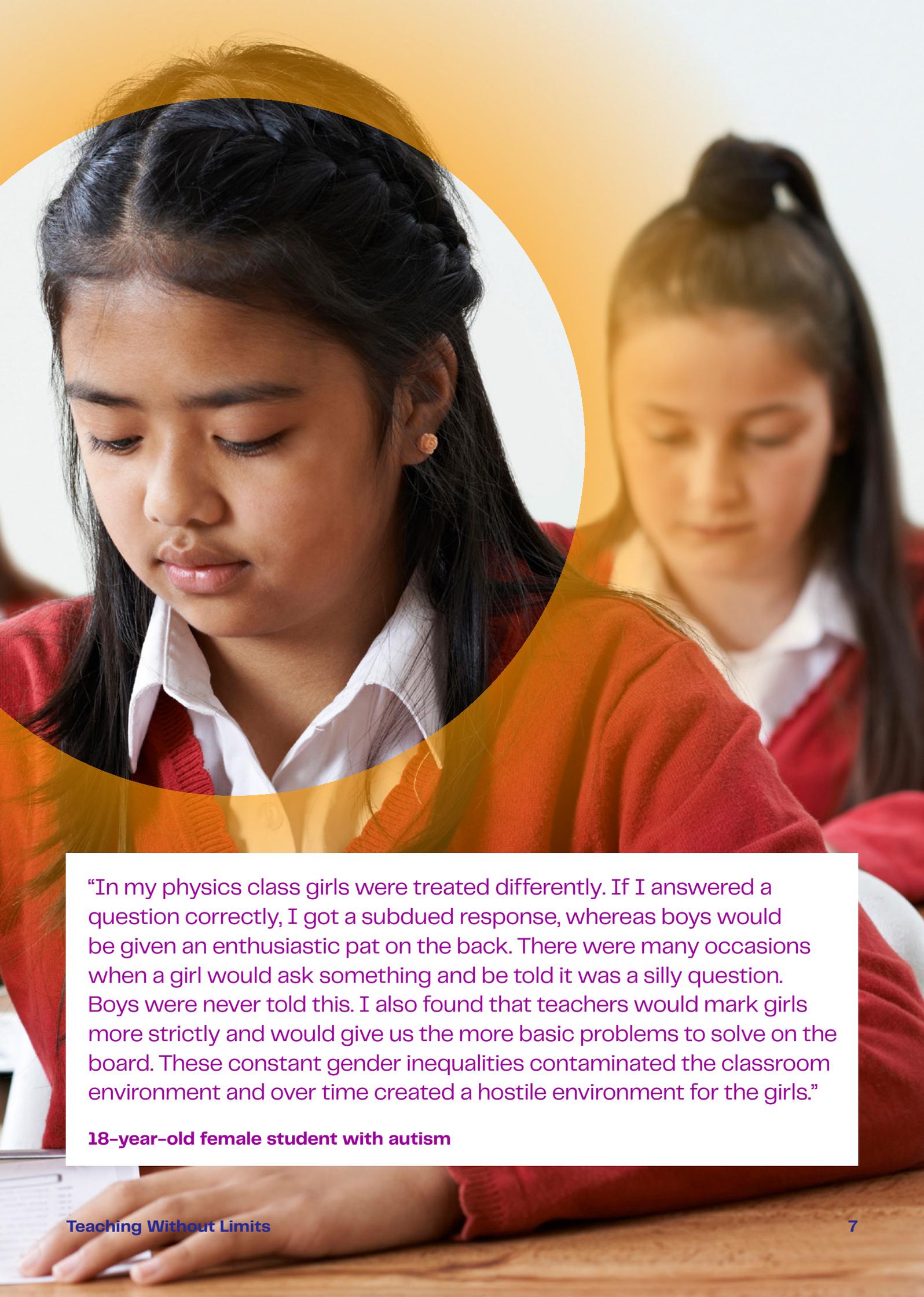


Which young people are we talking about?

The IOP has identified five groups that are currently underrepresented or underserved in the physics community – young people in these groups are less likely to do physics and more likely to face a [hostile environment](#) when they do. These groups are:

- Girls
- Young people from disadvantaged backgrounds
- Disabled young people
- LGBT+ young people
- Young people of Black Caribbean descent

This report explores the issues in encouraging young people from these groups to continue with the subject, as well as discussing some of the solutions. It also provides an overview of the available data relating to participation and attainment in physics beyond the age of 16, as well as the significant data gaps for certain groups.



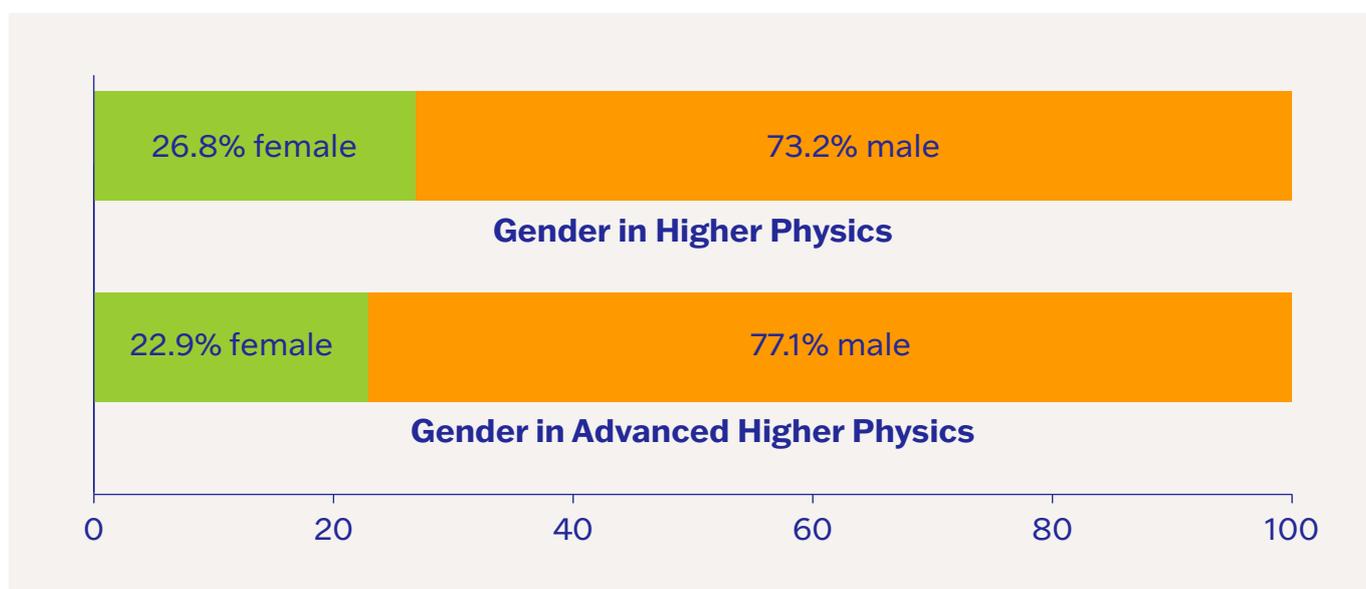
“In my physics class girls were treated differently. If I answered a question correctly, I got a subdued response, whereas boys would be given an enthusiastic pat on the back. There were many occasions when a girl would ask something and be told it was a silly question. Boys were never told this. I also found that teachers would mark girls more strictly and would give us the more basic problems to solve on the board. These constant gender inequalities contaminated the classroom environment and over time created a hostile environment for the girls.”

18-year-old female student with autism

The facts

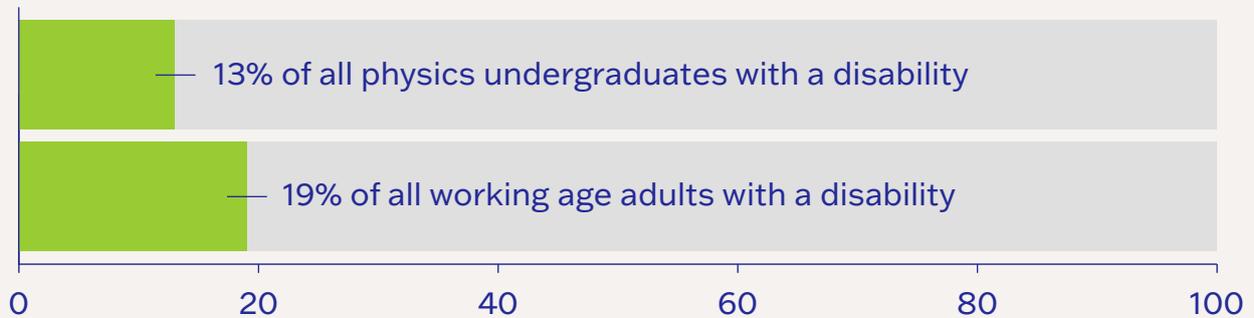
In 2021, of those choosing Higher Physics, only 26.8% (2275) were female compared to 73.2% (6206) who were male. The situation for Advanced Higher Physics is even worse with only 22.9% (446) female and 77.1% (1498) male.

The Scottish Qualifications Authority does not publish data on characteristics of candidates *other than gender*. Although the Scottish Government publishes data on the Scottish Multiple Index of Deprivation and the uptake of Free School Meals for different schools this such data is not linked to the individual candidates and the different subjects which they choose. Improved data is required to make objective comments about the uptake of physics, *or any other subject*, for other underrepresented groups *and to determine whether initiatives are improving the situation*.



Limited by disability

In 2017–18, 13% of physics undergraduates in the UK had a known disability. This is below the percentage for all working age adults (19%).



(Source: Higher Education Statistics Agency (2018), *Students in UK Physics Departments Report*. Available at: www.iop.org/sites/default/files/2020-07/Student-characteristics-2017-18.pdf)

How many young people from the underrepresented groups study physics in your school?
How could this be improved?

A word about data

When preparing this report, we wanted to present as complete a picture of the situation in Scotland as possible, with data related to each of the underrepresented groups. Unfortunately, this data is either not collected or is not publicly available. The IOP believes that more needs to be done by those responsible for young people's education to collect and publish data related to young people and the study of physics.

Why is there an issue?

For many years, the IOP has recognised the inequity in physics which has long existed in education, academia and the workforce.

Since the publication of "[Girls in the Physics Classroom](#)" in 2006, the IOP's understanding of the causes of imbalances, and the strategies to help overcome them, have developed considerably. However, despite efforts by the IOP and others to address this problem, the proportion of underrepresented students studying physics post-16 has stayed roughly the same over many years.

The IOP in Scotland has especially developed a good understanding of the issues around gender inequality in physics. In particular, the Improving Gender Balance and Equalities team in Scotland has recognised the importance of working with early years centres and primary schools as children as young as 3 or 4 have shown preferences for gendered work roles.¹

1 Fawcett Society: Gender Stereotypes in Early Childhood: A Literature Review (2019) Culhane, L. & Bazeley, A. [Download.ashx \(fawcettsociety.org.uk\)](#) in BSA: Inquiry on Equity in STEM Education (2020) [Download.ashx \(britishscienceassociation.org\)](#)

The Scottish government has recognised the benefits of the approach taken by the Improving Gender Balance Scotland pilot and has asked for the learnings to be rolled out to all schools by 2022. However, the focus of this project has been primarily on gender and significant barriers remain for participation in physics from other underrepresented groups.

Significant barriers remain for participation in physics throughout educational levels and these are more pronounced for underrepresented groups, leading to a vicious cycle of underrepresentation.

The personal experiences that have been shared with the IOP by our members and other physicists highlight some of the challenges young people face within the education sector when hoping to progress to post-16 physics, such as:

“When expressing to friends and family that I was interested in studying physics or engineering some were visibly shocked and even in a mock interview I was asked why I would want to go into a male orientated profession, would it not be easier for me to do something more traditionally female.”

18-year-old white female Scottish student with a specific learning disability

“Upon my unconditional offers to study Physics with Astrophysics, a classmate had conditional offers instead. They were bitter and claimed the only reason why my offer was unconditional despite our grades being the same was because I was a person of colour and a woman. He claimed I was a “diversity selection”. This is hidden from the university so they would never have known whether I was a woman or a person of colour. He couldn’t recognise that I was better than him, I had written a better statement, achieved more in my extra-curriculars and was a better leader than him.”

Female Scottish physics student (ethnicity not specified)

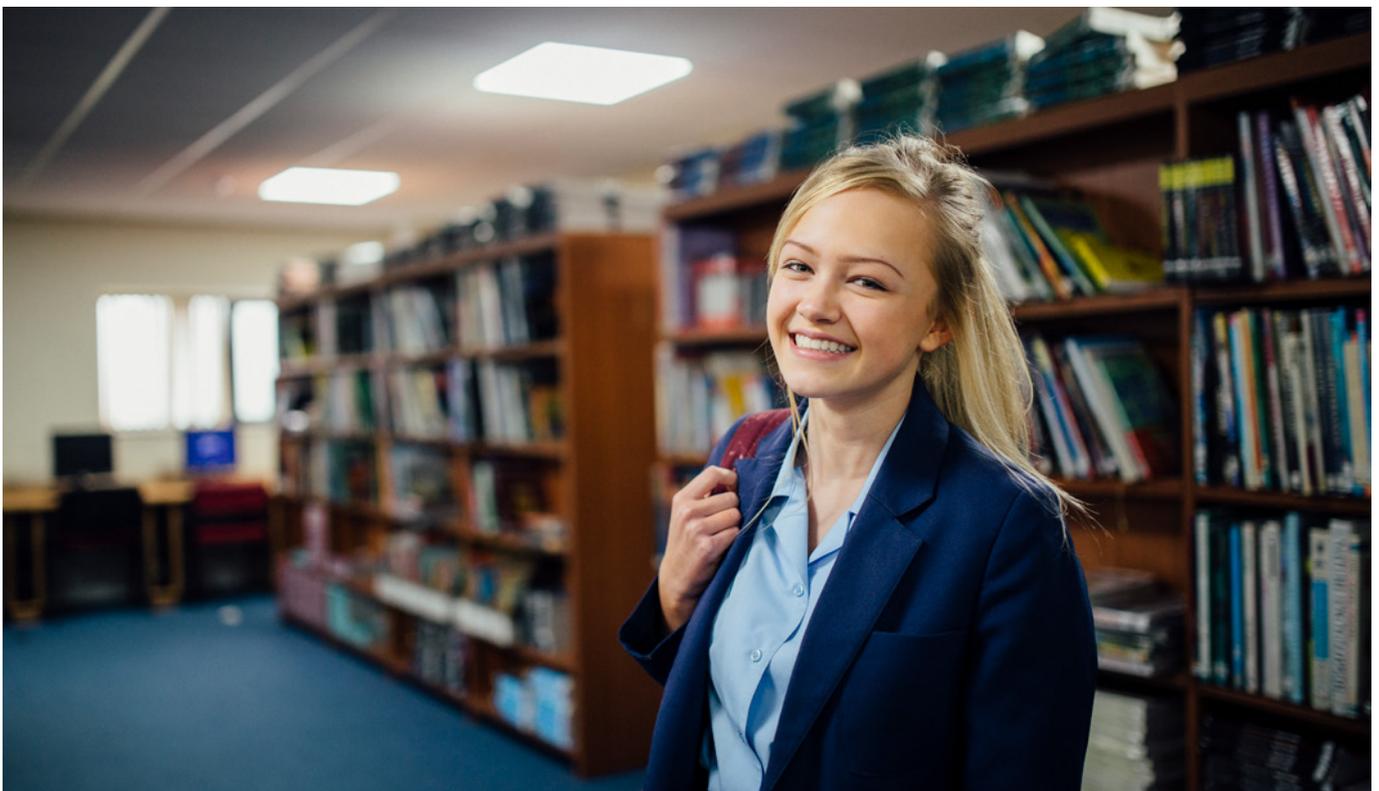
Our manifesto for change

The IOP is calling on the governments of the UK and Ireland to:

1. Revise professional standards for teachers to set out an expectation that teachers will address injustice in their professional practice and actively dismantle any sexism, racism, homophobia, ableism and classism from their own work and their schools.
2. Ensure that all teachers are trained to teach inclusively and to tackle injustice so that they can achieve these robust standards. This should be in both their initial teacher education and their continuing professional learning and development.
3. Direct those responsible for school inspections to place greater emphasis on the importance of inclusive teaching and schools' efforts to address injustice.
4. Mandate nurseries and schools to develop whole-school equity action plans that:
 - are informed by ongoing data and evidence collection including students' choices.
 - promote equity and equality for young people in underserved groups.

In all nurseries and schools, the IOP wants to see:

5. All staff challenge bias and stereotyping.
6. Educators, parents and students develop and implement whole-school equity action plans that provide an inclusive environment and promote equity and equality for young people in underserved groups.
7. Those responsible for school governance play an active role in ensuring that equity and equality are promoted in their schools and that inequalities are addressed, including appointing a member with specific responsibility for equality.
8. Teachers teach physics and science in an inclusive way that promotes a positive, contemporary view of physics and portrays physicists from a wide range of backgrounds including the underrepresented and underserved groups.
9. All young people and their parents and carers receive a high standard of careers advice that includes physics-related career options and promotes studying physics beyond age 16.
10. More young people from underserved groups benefit from learning outside the classroom, such as in science or STEM clubs.



A whole school approach to equity

Research by the IOP has indicated that school culture is a substantial factor in determining subject choice. One study, "[Closing Doors](#)", showed that 81% of state-funded, mixed schools in England were either maintaining or exacerbating the already poor gender imbalance of progression into English, mathematics, biology, physics, economics and psychology. The study also showed that to reduce the gender imbalance in one subject, the schools needed to look to reduce the imbalance in other subjects, further showing the importance of school culture. The conclusion of the data analysis was that gender imbalances arose from school culture, biases, and gendered expectations of students.

A subsequent study, "[Opening Doors](#)", looked at good practice in schools for countering such stereotyping. This research emphasised that to truly challenge biases and stereotyping, work must go beyond the physics classroom. For systemic and sustainable change, commitment is needed from students, teachers of physics and of other subjects, senior leaders, governors, trustees, parents and carers. When such approaches have been used, the impact has been significant. For example, the number of girls taking AS-level physics more than trebled in over two years following a whole-school challenge to address imbalances.



“A whole school equity plan is ensuring that the school (our community – so that’s the parents, the students, and the teachers) are all involved in coming up with a common vision: that every child in the community is entitled to that inclusivity and diversity of the curriculum that allows them to see beyond, not only what they have right now in front of them in terms of their own community but the wider picture, and they can then build upon when they go into society.”

Jamie Drake, Curriculum Director of Science and Social Science, Noel Baker Academy, Derby

Learn more at: iop.org/WholeSchool

86% of secondary school teachers who have whole school equity plans reported seeing positive change as a result of the plans being implemented.

Censuswide survey of 2000 primary and secondary school teachers across the UK and Ireland



A whole-school approach truly involves the whole school – areas to consider are shown below:

<p>Personal practice: supporting staff to reflect</p>	<p>All teaching and non-teaching staff within the school should be included in such work, trained to play an active role and made aware of the effect of biases, conscious and unconscious.</p>
<p>Student voice: putting young people at the heart of change</p>	<p>A crucial step is supporting children and young people in understanding and challenging injustice and stereotypes and allowing them ownership of the issues.</p>
<p>Curriculum and learning</p>	<p>Resources and the curriculum should be audited to ensure equal opportunities. Learners should be able to choose subjects and activities based on their preferences and skills, rather than being guided by their gender, race, sexual orientation, disability or background</p>
<p>Progression, choices and jobs</p>	<p>Everyone has a role to play in opening learners' eyes to the diversity and range of options available for their future, which should not be limited by their own or others' expectations</p>
<p>Internal and external communications</p>	<p>Schools communicate with a wider variety of audience including parents, carers, students, staff and the wider community. Processes should be put in place to make sure communication and materials counter stereotypes and do not reinforce bias.</p>
<p>Engagement with parents, carers and the wider school community</p>	<p>The biggest impact will be made when the whole school community works together. Involving parents and carers from the start can help children and young people challenge inequality in wider life.</p>

The Scottish context

Teachers in Scotland must be registered with the General Teaching Council for Scotland (GTCS) and, since these were introduced in 2002, meet the appropriate professional standards. These were revised in 2021² and the Standard for Full Registration now prioritises values of social justice, integrity, trust, and respect. Teachers are expected to show commitment to inclusive practices; motivating and including all learners; taking account of specific needs; recognising and reducing barriers to learning; and challenging discrimination.

The Institute of Physics welcomes this approach as an excellent base from which to ensure that equity, diversity, and inclusion issues are properly addressed and that every learner enjoys fair opportunities to succeed and excel. The Professional Standards should be met in all circumstances and all teachers must have the necessary support and resources to ensure they are firmly embedded in teaching habits and practices across the board.

² gtcs.org.uk/professional-standards/Standard-full-registration.aspx

The Scottish Government's STEM Education and Training Strategy³ also commits to reducing disadvantage and lifting up underrepresented groups. This adopted the outcomes of the successful Improving Gender Balance Scotland project, managed by the IOP, which are now being rolled out to all schools in Scotland by Education Scotland's Improving Gender Balance and Equalities team. Resources and research are available on the Improving Gender Balance and Equalities 3-18 website.⁴ This website includes Actions Guides for Early Learning Centres,⁵ Primary schools,⁶ and Secondary schools.⁷ Although the pilot project focused on gender, it is important that broader equalities factors are addressed in future.

3 [gov.scot/publications/science-technology-engineering-mathematics-education-training-strategy-scotland/](https://www.gov.scot/publications/science-technology-engineering-mathematics-education-training-strategy-scotland/)

4 [education.gov.scot/improvement/learning-resources/improving-gender-balance-3-18](https://www.education.gov.scot/improvement/learning-resources/improving-gender-balance-3-18)

5 [education.gov.scot/media/ka2k1m0p/sci38-elcc-action-guide.pdf](https://www.education.gov.scot/media/ka2k1m0p/sci38-elcc-action-guide.pdf)

6 [education.gov.scot/media/vvogktrj/sci38-primary-action-guide.pdf](https://www.education.gov.scot/media/vvogktrj/sci38-primary-action-guide.pdf)

7 [education.gov.scot/media/h0bjc0ap/secondaryactionguidemay2018.pdf](https://www.education.gov.scot/media/h0bjc0ap/secondaryactionguidemay2018.pdf)



71.4%
of secondary school teachers in the UK and Ireland agreed that societal issues, such as equity and inclusion, have a place in subject specific teaching.

Censuswide survey of 2000 primary and secondary school teachers across the UK and Ireland

What you can do

To build a fairer and more inclusive environment in schools for young people from underrepresented and underserved groups we need your support. Today you can take the following actions:

1. Sign up to the manifesto

Please sign up to the manifesto today so that we can show our politicians that we have widespread support for improving equity and inclusion across the education sector. To sign up on behalf of your school or as an individual teacher, or both, please visit <https://campaign.iop.org/manifesto>.

With your help we will call on the government in Scotland to provide more support for teachers to create inclusive school environments. We will take our message to MSPs, parliamentary groups, government officials, and local authority councillors and officials to get their support in both government and in the media and push for concrete changes.

2. Learn more about the Limit Less campaign and share!

Visit the main Limit Less campaign page iop.org/LimitLess to find out more about the campaign, view resources, and read stories from people who were deterred from physics because of who they are.

We have a growing number of individual supporters and would welcome even more. Please share this link with your friends and family and ask them to join as individual supporters, the more people who join our campaign, the more likely we are to change young people's future for the better.

3. Tell us about your whole school approach

If your school has already adopted a whole school approach and is building an inclusive environment for all students, we would be very interested to hear from you, both to celebrate your success and so that others can learn from your activities. Please contact us at campaigns@iop.org.

“I grew up on a small island in the Firth of Clyde (the Island of Bute) with a population of around 7000 people and one secondary school. Only one member of my larger family had gone to university – my mother’s brother had studied aeronautical engineering at Glasgow University. My father was in the merchant navy, spending long periods at sea, and my mother was a housewife. Up until the age of about 12 my main interests at school were English – I enjoyed writing poems and short stories – and history. However, when I moved to the secondary school and first had the opportunity to carry out experiments in the science classes I was hooked and knew that I wanted to be a scientist. I devoured science fiction novels and biographies of famous scientists (the biography of Marie Curie left a big impression on me and convinced me that it might be possible to follow a scientific career) and enjoyed carrying out “experiments” in the kitchen at home.

I was particularly interested in physics and chemistry. Physics challenged me more than chemistry and I had to work harder to understand the concepts (a challenge that I greatly enjoyed – this continued to be the case after I moved to university to study chemical physics). However, the physics teacher did not want to have girls in his Higher Physics class (he often said to the class “girls can’t do physics”, perhaps also as a means to spur on the boys – in our class there were two girls taking physics and we always had the best exam results). He made it very clear that in his opinion girls should choose biology instead of physics. I was only able to continue to study physics after the

chemistry teacher intervened and persuaded him that I would need physics if I decided to study medicine. I actually think he believed that he was giving us good advice, in his view of the world females did not "do physics" – in later years, to be fair to him, he was always very pleased to hear about what I was doing when he happened to meet my mother.

The attitudes of these teachers mainly inspired me to show them that they were wrong but it could quite easily have had a much more negative impact. Fortunately, there were others (particularly the chemistry and maths teachers) who were very supportive and encouraged me to study science – and were not shocked or surprised when I decided not to accept the place I was offered to study medicine in order to study chemical physics.

Nowadays it is less unusual for girls to study physics at school or university and there is a more encouraging atmosphere however there is still some work to be done to persuade the majority of teenage girls that physics is a fascinating and valuable subject that is also for them."

**Professor Eleanor Campbell – Chair of Chemistry,
University of Edinburgh**



iop.org/LimitLess