
What makes a Professional Chemist? Embedding Equality, Diversity, and Inclusion into Chemistry Skills Training for Undergraduates.

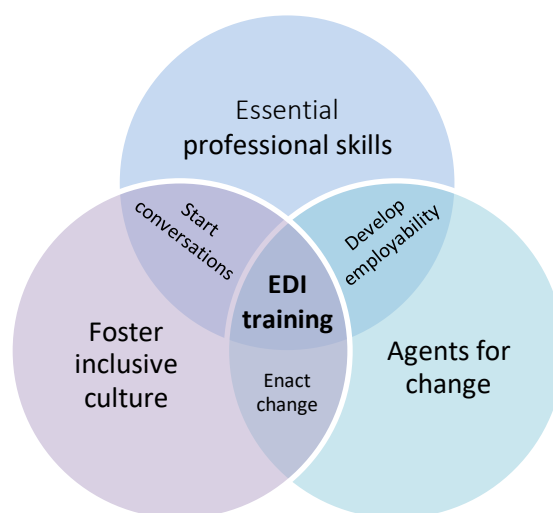
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ABSTRACT

The recent introduction of an online undergraduate equality, diversity, and inclusion (EDI) training workshop incorporating short authentic videos from a diverse range of voices is described. The training was designed to provide students with insights into how they can access support, act as allies, and respect diverse peers, preparing students for a professional life in chemistry. Embedding EDI training into a compulsory first year skills module was proposed to be an effective way to emphasize the importance of this topic. Usage statistics, instructor reflections and student feedback were used to evaluate the workshop and the implications for practitioners and future development of these online resources were considered. All of the materials and resources have been made available in the supplementary information and on YouTube in order to support and encourage other institutions to embed the teaching of EDI principles into their Science, Technology, Engineering and Mathematics (STEM) undergraduate programs.

GRAPHICAL ABSTRACT



KEYWORDS

Minorities in Chemistry, Women in Chemistry, First-Year Undergraduate / General, Curriculum, Distance Learning / Self Instruction, Misconceptions / Discrepant Events, Multimedia-Based Learning, Applications of Chemistry, Second-Year Undergraduate, Inclusive Teaching, Cultural Relevance.

Introduction

It is widely recognized that underrepresentation of women and minoritized groups is detrimental to the chemical sciences, with unequal participation leading to a loss of talent across the discipline, especially at higher professional levels.¹⁻⁶ Structural and attitudinal barriers exist throughout science careers,⁷ and despite considerable effort to improve equity, progress is slow.^{8, 9} Recently there have been a number of calls to action to drive forward lasting change in the culture of chemical workplaces, and hence create a fully diverse workforce.¹⁰⁻¹⁴

The chemical industry is increasingly recognizing that female leadership in organizations produces a competitive difference for companies.¹³ Having visible leadership on Inclusion and Diversity is therefore essential to a company's future success.¹⁵ Gender diversity is progressing steadily across the global chemical industry,^{10,16} and research has shown that companies with significant numbers of female leaders perform better than their competitors.¹⁷ This situation seems to be related to the ability of more diverse companies to attract the best talent and improve their business culture.¹⁸

In the UK higher education arena, the Athena SWAN Charter and awards scheme has been central to driving improvements in gender equality.^{19, 20} As a consequence of work performed under the charter, Equality, Diversity and Inclusion (EDI) training and unconscious (implicit) bias training are now common place for staff at Higher Education (HE) institutions in the UK, especially for those in decision-making roles.²¹ However, despite the growing recognition of the importance of EDI training both for careers within academic environments and leading business organizations, specific training is rarely incorporated into chemistry undergraduate degree courses.²² Diversity training has been incorporated into the education of undergraduate students on vocational courses, particularly medicine,^{23, 24} however, the value of such training for undergraduates studying science or engineering courses is much less established.

Training undergraduate chemists in EDI is important beyond the more traditional (practical, theoretical and transferrable) skills, which an undergraduate chemistry degree delivers.²⁵⁻²⁷ EDI training will better prepare our students to be professional chemists in the modern workplace. Furthermore, it should also improve the sense of belonging for minoritized individuals,^{28, 29} increase the diversity of ideas that individuals are comfortable to raise, and hence improve creativity. This has been reported in medicine, where the positive impact of undergraduate EDI training on workplace outcomes has been evidenced.²⁴

The Chemistry Department at the University of York has been a pioneer for gender equality, acknowledged through four prestigious Athena Swan Gold awards.^{20, 30} It works to further all aspects of EDI, and strives to provide a working, learning, social and living environment that will enable all our staff and students to flourish and excel. York

Chemistry introduced EDI training as face-to-face workshops into its postgraduate and undergraduate curricula in 2016 and 2017 respectively. However, the Covid-19 pandemic necessitated a move to online delivery, and the associated redevelopment process offered an exciting opportunity to update and refocus the session by incorporating the lived-experiences of a diverse range of voices from across the Department. In this contribution, we describe our online undergraduate EDI workshop and reflect on the advantages of introducing such training into an undergraduate chemistry program. The materials and resources have been made available in the supplementary information and on YouTube³¹ to support and encourage other institutions to embed student EDI training into their programs.

Aims and benefits of the EDI workshop

The introduction of EDI training at the start of the first-year undergraduate course was intended to give students an “appreciation of inclusivity”³² as a foundation on which to develop their own professional values, identity and cultural competence.³³ Figure 1 illustrates the aims of the EDI workshop in terms of its benefits to students, the Department, and the chemical community. Both the face-to-face and online training were developed around these aims using ‘backward design’.³⁴ We made an intentional decision to omit learning objectives for this training. This decision was made because each student will approach this workshop with very different personal experiences and awareness of EDI, which means that they will achieve different things from the training. Instead, the aims and benefits of the training were articulated in the introductory section of both workshops. The overarching aims are to: develop essential professional skills, foster an inclusive culture within the Department, and support students to become agents for change, these are discussed below:

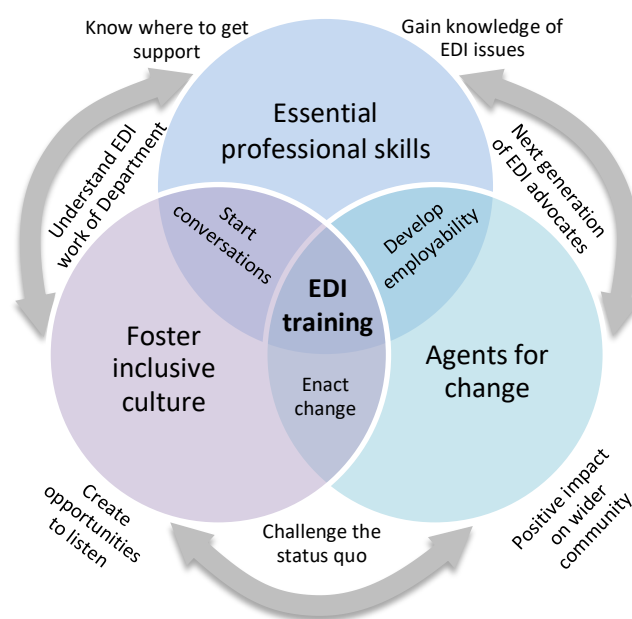


Figure 1: Key aims of the undergraduate equality, diversity, and inclusion workshop.

Essential professional skills

A primary aim of our EDI workshop is to help students develop their professional skills and awareness of their personal identity. By embedding and badging the EDI training alongside other key skills in chemistry (e.g. literature searching and critical thinking), we send a strong message about the value placed on EDI principles as a central part of becoming a professional chemist.

It is made clear to students that they are being trained as future leaders. After graduation, many of them will be responsible for the line-management of staff, and some will ultimately enter senior leadership roles. Employers are increasingly signaling the value they place on EDI skills through initiatives to promote diversity,¹⁰ for example GSK has rolled out new inclusion training and targets to increase representation,³⁵ whilst AstraZeneca now includes aspects of EDI into their job descriptions.³⁶ For this reason, a working knowledge of EDI has become essential knowledge for chemistry graduates. Students are provided with many opportunities to apply these skills during their degree such as during group projects and peer mentoring. Additionally, many of our postgraduate students are employed as graduate teaching assistants (GTAs), where the Department expects them to interact with the students they teach in a way that is fully consistent with its EDI principles and vision.³⁷

Fostering an inclusive culture

We aspire to help our undergraduates appreciate that the Department has an inclusive culture as one of its core values. This in turn should support students in starting conversations about their own lived-experiences. By hearing senior academic(s) speak passionately about EDI, we hoped to establish an acceptance of inclusivity at an early stage of our students' career journey and allow them to feel properly embedded within our department. Beyond a set of "*paper policies*", we want students to experience our inclusive "can-do" culture at both an emotional and intellectual level and understand how they can benefit from and contribute to that positive culture. It is also important to ensure individuals know what support is available, and how to access that support should they need it, including by contacting the staff featured in the videos.

Agents for change

Finally, we want our students to feel able to act as allies and activists to challenge the status quo, to report excluding or discriminatory actions where they perceive them, and to understand that the Department will support them. We believe that developing the skills and confidence to influence the culture of their working environment will benefit students in their professional life and also have a positive impact on the wider community. The Department uses a biennial "culture survey" to monitor the students' experience and

awareness of EDI matters, including whether they would feel able to report an issue, this will allow us to assess the impact of the training over the longer term.

Context of the EDI workshop within the curriculum

The undergraduate EDI workshop is delivered to all chemistry undergraduates (180-216 full-time students studying solely on chemistry programs, 41% female, *c.a.* 10% Black, Asian or minority ethnic and *c.a.* 18% have declared a disability) in the first semester of University study. The session is embedded into the “Skills for Chemists” module which is a compulsory 10 credit module that provides students with vital skills required for their degree program, offering a foundation in mathematics, physics, biology, coding and becoming a professional chemist [see Figure 2]. Timetabling the workshop early in the undergraduate program emphasizes the importance the Department places on EDI as an essential part of professional training.³⁸

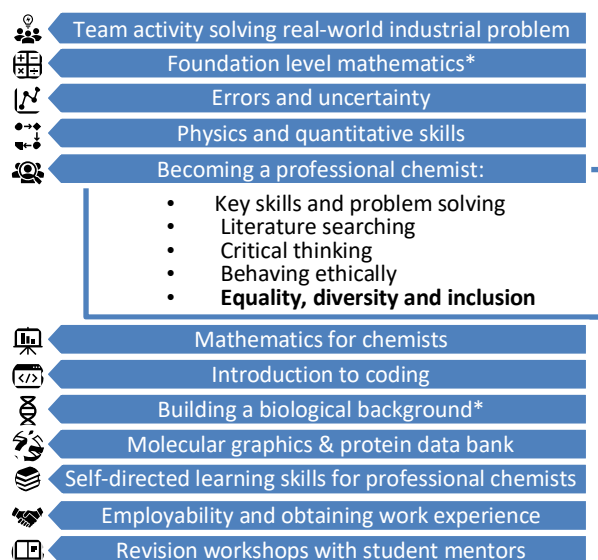


Figure 2: Overview of undergraduate “Skills for Chemists” compulsory 10 credit module (100 hrs work) which takes place during autumn and spring of year one. Students undertake all activities except *foundation level courses taken only by those without post-16 qualification in the subject. Becoming a professional chemist section expanded to show individual sessions (shown in black) including equality diversity and inclusion workshop.

Overview of previous face-to-face EDI workshop

The face-to-face undergraduate EDI workshop was introduced in 2017 and delivered by the (then) Chair of the Departmental Equality and Diversity Committee, Professor Paul Walton, and Dr Leonie Jones, the Employability and Diversity Officer. To the best of our knowledge, we were the first chemistry department in the UK to introduce EDI training for undergraduate students.

The session was scheduled as a two-hour face-to-face workshop in a flat classroom (run twice to accommodate all students) and comprised the following topics/elements:

- Introduction (5 min).
- Gender equality in academia (15 min).
- Unconscious bias including visual demonstrations (15 min).
- Team based multiple choice quiz (20 mins).
- Team based CV shortlisting exercise (1 hr).

Feedback from the face-to-face workshop was generally positive (52% participants found it very useful, 41% somewhat useful, 7% not useful). The talk on gender equality and unconscious bias was well received.

“A very interesting and informative workshop. I didn’t realize how large the gender bias in academia was before.” “Interesting statistics, group activities gave a balanced overview, useful session for personal reflection”

The team-based quiz featured facts and figures on gender equality designed to challenge students’ perceptions. This was used successfully as a mechanism to stimulate a lively discussion. However, the CV shortlisting exercise (loosely based on the 2012 Moss-Racusin paper)³⁹ designed to illustrate the principles of unconscious bias in recruitment became unreliable after the first year that it was used, likely due to the ‘trick’ of the exercise being known to some participants.

One theme that came through clearly in student feedback, was a desire to learn about further aspects of diversity beyond gender, in particular ethnicity and LGBT+ issues.

“Issues other than gender inequality i.e. racism, sexual orientation etc.”

Redevelopment of the EDI training for online delivery.

The requirement to move teaching online during the Covid-19 pandemic provided an opportunity for us to redevelop the workshop. Key principles guiding the design of the new online training were to:

- Create an effective learning environment for students.
- Be accessible and inclusive.
- Incorporate a broad range of diversity topics and consider intersectionality.

Our experience of rapidly ‘pivoting’ the equivalent postgraduate EDI session to online delivery earlier in autumn 2020 influenced the development of the undergraduate workshop. Postgraduates undergo a series of introductory skills workshops. A conventional approach of providing lecture recordings resulted in a marked drop in attendance/uptake for sessions (from around 78% in 2019 to just 22% in 2020 for the EDI session) suggesting that this approach was not suitable.

Taking into account the previous feedback that a broader range of topics would be welcomed by learners, and making use of the online format, it was decided to refocus the session and invite contributions from a diverse range of staff. The redeveloped session was hosted on the University's Virtual Learning Environment (VLE) and contained the following elements (see Figure 3):

- A series of six short videos of staff from the Department of Chemistry at the University of York, talking about different aspects of diversity (~50 min in total).
- Links to relevant resources and extension activities which students were encouraged to use to engage more deeply with the issues (10-20 min).
- An interactive activity on understanding unconscious bias using the Harvard implicit association test (20-30 min).⁴⁰
- A synchronous Q&A session over Zoom led by the Chair of EDI and Employability and Diversity Officer (30 min).

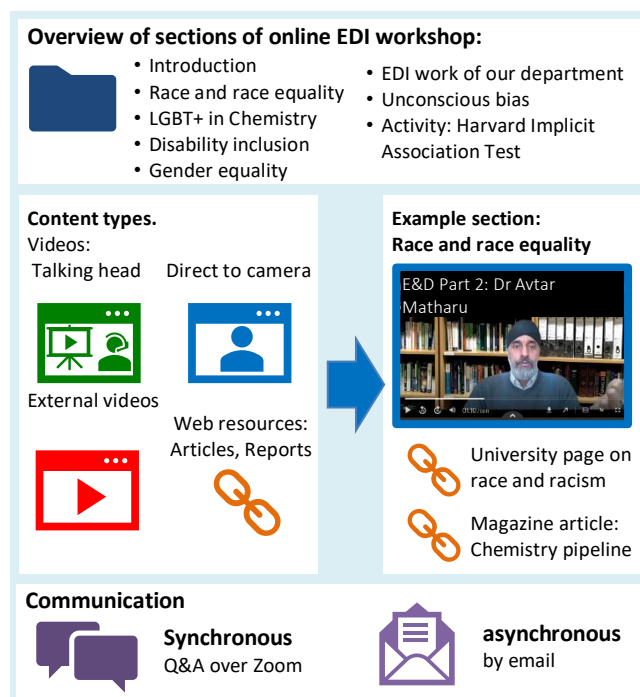


Figure 3: Schematic of online EDI workshop delivered through Virtual Learning Environment (VLE). All of the content of the online workshop is available in full in the supplementary information and videos hosted on YouTube.³¹ Full list of Links to videos and external resources in supplementary material.

The session was launched during the last week of November 2020 with asynchronous materials made available at the start of the week and a synchronous Q&A session held over Zoom at the end of the week. Students were advised to allow around 2 hours (the length of time the face-to-face workshop was timetabled for) and encouraged to work through the online materials before the Q&A session.

In total six members of staff, all members of the Department's EDI committee contributed recordings. They shared a range of professional expertise and lived-experience (gender; staff roles; levels of seniority; LGBT+ individuals; minority ethnic individuals; and those having physical and mental health conditions) including intersectional identities. Due to sensitivities around both staff and student workload, it was suggested video contributions should be kept to between 3-15 minutes long. Staff were given little direction in terms of content beyond the topic (ethnicity, LGBT+, disability inclusion, gender equality) although individuals were selected who had appropriate EDI knowledge and were aware of the ethos and aims of the training. The recordings covered a range of content including: why EDI is important to the Department; personal reflections on aspects of diversity; information on the EDI work of the Department; examples of student activism and allyship; factual information (e.g. on unconscious bias) and sources of support for students.

The move to an online format had the benefit of increasing inclusivity. Students were able to work through captioned videos and other resources at their own pace. The VLE used to deliver the course was already familiar to learners and material was structured in a similar way to previous material to aid navigation. The platform has built in accessibility features including: closed caption provision; zoom up to 300% without text spilling off screen; keyboard navigable; listenable using screen readers; navigable using speech recognition software; customizable colors.

A synchronous Q&A session over Zoom was designed to help learners feel connected to the session. The online discussion was facilitated by two experienced staff members with knowledge of EDI in Science, Technology, Engineering and Mathematics (STEM) allowing students to reflect on and interrogate their beliefs and preconceptions. A wide range of topics were covered, from student unconscious bias in providing feedback on individual lecturers to regional accents. As in previous face-to-face workshops, some students expressed surprise that gender equality was (still) an issue for women in academia, demonstrating the continued importance of EDI awareness. Participants were invited to contribute to the discussion in a number of ways; by unmuting their microphones, via the chat to the whole group or privately to the instructors. The most common method of student interaction was using the text chat function within Zoom. Some participants did not use either the audio or text chat options, which may indicate, perhaps unsurprisingly, that students did not feel fully able or comfortable to contribute to the discussion in Zoom with a high number of relative strangers, for this reason it may be beneficial to set up a mechanism for students to submit questions in a fully anonymized way.

Evaluation of the online EDI workshop

The redeveloped online workshop was evaluated by autobiographical instructor reflections, student usage statistics of online items, viewing statistics, anonymous student

feedback, and students' comments by email. Explicit permission was received for quotes where the identity of the author was known.

Instructor reflections:

A key benefit of moving to an asynchronous approach with pre-recorded material was that it allowed the involvement of a greater, more diverse group of staff, including those with intersecting minoritized identities. Reflecting on the accessibility of the format, Dr Julia Sarju reported that *"The use of short videos was an accessible format both for students and instructors; allowing a variety of staff to contribute to the course. Working part-time, it would have been difficult to schedule live sessions with all contributing colleagues."* This is a feature that should be retained in the return to face-to-face teaching, for example in a blended approach such as showing videos during the training or "flipping" part of the workshop.

Creating videos has allowed us to introduce concepts of EDI in an authentic way whilst exposing students to a variety of role models.⁴¹ Instructors speak candidly, for example sharing personal accounts and lived-experiences of (micro)aggressions while exploring examples of student and staff allyship. This authenticity is important. Simple acts such as sharing personal photographs or referring to their children's noises in the background, are powerful in terms of personalization⁴² and normalizing life outside of the laboratory.

Instructors commented on the liberating power of the opportunity to address the student body on EDI issues.⁴³ Professor David Smith said: *"LGBT+ diversity is often hidden. Many students starting at University are perhaps exploring aspects of themselves for the first time,⁴⁴ but are unsure how to navigate this within a professional context. The opportunity to reflect on this and discuss the support available was very welcome. Hopefully this empowers students to be who they really are, but also produces many more allies and active bystanders, which will help make the Department more inclusive."*

Something that has been striking during the five years since our EDI training was first developed is how fast-moving EDI is as a field. There have been significant changes in levels of knowledge, cultural attitudes,⁵ and the evolution of language,⁴⁵ which have important implications for how instructors prepare for and review the EDI workshop each year. It is important that prerecorded materials are kept up-to-date and that instructors are well prepared to answer questions (and potentially manage debate) in live sessions whether online or face-to-face.

Student engagement

The student viewing statistics for the video recordings in this online EDI workshop show that engagement was 50% for the first recording, only dropping to 42% for the final recording (between 84-102 unique users for each video). This is lower than the 79% attendance recorded for the previous face-to-face workshop but compares favorably with other unassessed skills material in the module, e.g. Employability (44%-32% student

views). The majority of users (76-82%) viewed some or all of the recordings during the four days between the launch and the Q&A session, with a significant minority (17-25%) accessing the recordings subsequently.

The following quote illustrated some of the student feedback we obtained:

"I just wanted to say thank you for the talk this morning. I found it really interesting, and I loved working through the materials. I thought the way in which the course was structured with the smaller videos for different "areas" was really helpful and made it really accessible."
[First year undergraduate student, by email].

Further discussion

It is well established that scientists respond better to skills training if they view it as being a key part of their subject learning.³² Throughout the module, we often take an evidenced based, 'scientific' approach to addressing EDI issues. In particular, in the area of gender equality, we make extensive use of statistics and peer-reviewed studies. This approach is familiar to STEM students. Many STEM practitioners feel nervous, or even suspicious approaching a topic which might be considered a better fit in a social science degree. The importance and influence of data on scientists in the EDI space should not be underestimated and our approach aligns with the Inclusion and Diversity Strategy of the Royal Society of Chemistry.²

A key question considered during course development was whether it would be assessed. An advantage of assessment would be an additional signal to students that an understanding of EDI is a necessary skill, and there is also a perception that including an assessed element might improve attendance by providing an extrinsic motivation.⁴⁶

Historically, the face-to-face session was well attended and so it was felt that introducing an assessment was unnecessary. Viewing statistics suggest lower engagement for the online videos but this is understandable given the context in which they were delivered. The Covid-19 pandemic has meant student workload and assessment anxiety have increased, and consequently we felt it was inappropriate to introduce a new assessment. When study conditions return to normal, however, we plan to introduce a short compulsory online multiple-choice quiz, to test the students' understanding of the course material.

Our reflections on the workshop we developed have led us to identify the following implications and recommendations for practitioners.

- Embedding EDI awareness as key skills for professional chemists into the core curriculum signals to students that these skills are important, valued, and expected by the Department.

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- Incorporating an EDI session early in the degree program has the potential to enable students to better work in an inclusive manner with their peers as well as creating a cohort of students prepared to act as agents for change.
 - Workshops and resources need to be effective and accessible for all students taking part. This can be achieved through a combination of inclusive design and making individual arrangements.
 - Use of data to support discussions, gives an evidence-based approach to EDI that appeals to the typical STEM student.
 - Ideally, instructors should be able to speak authentically about their own experiences and/or professional knowledge of EDI issues. Although this can create additional work for members of minoritized groups,^{47, 48} which must be recognized and mitigated elsewhere, it is of very high value to the students.
 - Facilitators should be sensitive to the fact that students taking part may have experienced trauma related to content. It is important to include contacts for support and resources for further information and to consider if trigger warnings may be appropriate for sensitive topics.
 - The content of the training should be responsive to the students, the changing student environment, and evolving societal factors

Conclusion

As University educators, we believe we have a responsibility for social justice and to further the common good.⁴⁹ In particular, we have an important role to play in addressing widespread inequalities in STEM education, careers, and beyond. Embedding EDI into a skills module is an effective way of emphasizing the importance of this topic, providing students with insights both into how minoritized students can access support, but also showing all students how they can act as allies, and respect diverse peers with a variety of points of view. This prepares our students for a professional life in chemistry where many will take on leadership positions.

We found that incorporating short authentic videos from a diverse range of voices is a powerful way of highlighting EDI and introducing students to a range of different ideas. Hearing staff talk about their own experiences, or their professional insights into EDI, supported by data and evidence, engages students with the subject and allows them to see its practical relevance in the real-world.

ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available on the ACS Publications website at DOI: 10.1021/acs.jchemed.XXXXXXX.

1. Full outline of online EDI workshop, videos, resources and extension activities (PDF).

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REFERENCES

- (1) Royal Society of Chemistry. *Diversity Landscape of the Chemical Sciences: A Report by the Royal Society of Chemistry*. https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/cm-044-17_a4-diversity-landscape-of-the-chemical-sciences-report_web-2.pdf (accessed 2021-09-10).
- (2) Royal Society of Chemistry. Inclusion & Diversity Strategy to 2025: Enabling Inclusive Access and Progression in the Chemical Sciences. <https://www.rsc.org/globalassets/22-new-perspectives/talent/inclusion-and-diversity/strategy/rsc-inclusion-diversity-strategy-2025.pdf> (accessed 2021-09-10).
- (3) Royal Society of Chemistry. Breaking the Barriers; 2018, https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/womens-progression/media-pack/v18_vo_inclusion-and-diversity-womans-progression_report-web-.pdf (accessed 2021-09-10).
- (4) National Science Foundation, Directorate for Social, Behavioral and Economic Sciences, National Center for Science and Engineering Statistics. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019*, NSF 19-304. <https://nces.nsf.gov/pubs/nsf19304/> (accessed 2021-09-10).
- (5) Menon, B. R. K. The Missing Colours of Chemistry. *Nature Chemistry* **2021**, 13 (2), 101–106, 10.1038/s41557-020-00632-8.
- (6) Royal Society of Chemistry. *Exploring the Workplace for LGBT+ Physical Scientists: A Report by the Institute of Physics, Royal Astronomical Society and Royal Society of Chemistry*. https://www.rsc.org/globalassets/04-campaigning-outreach/campaigning/lgbt-report/lgbt-report_web.pdf (accessed 2021-09-10).
- (7) Grogan, K. E. How the Entire Scientific Community Can Confront Gender Bias in the Workplace. *Nature Ecology & Evolution* **2019**, 3 (1), 3–6; 10.1038/s41559-018-0747-4.
- (8) Holman, L.; Stuart-Fox, D.; Hauser, C. E. The Gender Gap in Science: How Long until Women Are Equally Represented? *PLOS Biology* **2018**, 16 (4), e2004956; 10.1371/journal.pbio.2004956.
- (9) World Economic Forum. Global Gender Gap Report, March 2021. <https://www.weforum.org/reports/ab6795a1-960c-42b2-b3d5-587eccda6023> (accessed 2021-09-10).

-
- (10) Ruck, R. T.; Faul, M. M. Update to Editorial “Gender Diversity in Process Chemistry”. *Org. Process Res. Dev.* **2021**, *25* (3), 349–353; 10.1021/acs.oprd.0c00471.
- (11) Ackerman-Biegasiewicz, L. K. G.; Arias-Rotondo, D. M.; Biegasiewicz, K. F.; Elacqua, E.; Golder, M. R.; Kayser, L. V.; Lamb, J. R.; Le, C. M.; Romero, N. A.; Wilkerson-Hill, S. M.; Williams, D. A. Organic Chemistry: A Retrosynthetic Approach to a Diverse Field. *ACS Central Science* **2020**, *6* (11), 1845–1850, 10.1021/acscentsci.0c01138.
- (12) Sanford, M. S. Equity and Inclusion in the Chemical Sciences Requires Actions not Just Words. *J. Am. Chem. Soc.* **2020**, *142* (26), 11317–11318, 10.1021/jacs.0c06482.
- (13) Reisman, S. E.; Sarpong, R.; Sigman, M. S.; Yoon, T. P. Organic Chemistry: A Call to Action for Diversity and Inclusion. *J. Org. Chem.* **2020**, *85* (16), 10287–10292, 10.1021/acs.joc.0c01607.
- (14) Wilson-Kennedy, Z. S.; Payton-Stewart, F.; Winfield, L. L. Toward Intentional Diversity, Equity, and Respect in Chemistry Research and Practice. *J. Chem. Educ.* **2020**, *97* (8), 2041–2044, 10.1021/acs.jchemed.0c00963.
- (15) Phillips, K. W. How Diversity Works. *Sci. Am.* **2014**, *311* (4), 42–47, 10.1038/scientificamerican1014-42.
- (16) Trager, R. Stepping towards Diversity in Industry. *Chemistry World*, 2020. <https://www.chemistryworld.com/news/stepping-towards-diversity-in-industry/4012648.article> (accessed 2021-09-10).
- (17) Yanosek, K.; Abramson, D.; Ahmad, S. How Women Can Help Fill the Oil and Gas Industry’s Talent Gap. McKinsey & Company, October 2019. <https://www.mckinsey.com/~media/McKinsey/Industries/Oil%20and%20Gas/Our%20Insights/How%20women%20can%20help%20fill%20the%20oil%20and%20gas%20industrys%20talent%20gap/How-women-can-help-fill-the-oil-and-gas-industrys-talent-gap-final.pdf?shouldIndex=false> (accessed 2021-09-10).
- (18) GPCA. The Role of Workforce Diversity in the Chemical Industry. <https://www.gpca.org.ae/2021/03/07/the-role-of-workforce-diversity-in-the-chemical-industry/> (accessed 2021-09-10).
- (19) Advance HE. <https://www.advance-he.ac.uk/equality-charters/athena-swan-charter> (accessed 2021-09-10).
- (20) Barnard, S. The Athena SWAN Charter: Promoting Commitment to Gender Equality in Higher Education Institutions in the UK. In *Gendered Success in Higher Education: Global Perspectives*, White, K., O’Connor, P., Eds.; Palgrave Macmillan: London, 2017; pp 155–174.
- (21) Advance HE. The Importance of EDI in Higher Education. <https://www.advance-he.ac.uk/guidance/governance/governance-and-edi/importance-edi-higher-education> (accessed 2021-09-10).

-
- (22) Raycroft, M. A. R.; Flynn, A. B. What Works? What's Missing? An Evaluation Model for Science Curricula That Analyses Learning Outcomes through Five Lenses. *Chem. Educ. Res. Pract.* **2020**, *21* (4), 1110–1131, 10.1039/C9RP00157C.
- (23) Davis, D. L. F.; Tran-Taylor, D.; Imbert, E.; Wong, J. O.; Chou, C. L. Start the Way You Want to Finish: An Intensive Diversity, Equity, Inclusion Orientation Curriculum in Undergraduate Medical Education. *J. Med. Educ. Curric. Dev.* **2021**, *8*; DOI: 10.1177/23821205211000352.
- (24) Miah, J.; Haque, E.; Thampy, H. Diversity Training for Medical Students: Evaluating Impact. *Educ. Primary Care* **2020**, *31* (1), 54–56, 10.1080/14739879.2019.1691470.
- (25) Overton, T.; McGarvey, D. J. Development of Key Skills and Attributes in Chemistry. *Chem. Educ. Res. Pract.* **2017**, *18* (3), 401–402, 10.1039/c7rp90006f.
- (26) Quality Assurance Agency for Higher Education. Subject Benchmark Statement for Chemistry. <https://www.qaa.ac.uk/docs/qaa/subject-benchmark-statements/subject-benchmark-statement-chemistry.pdf> (accessed 2021-09-10).
- (27) Handson, S.; Overton T. *Skills Required by New Chemistry Graduates and Their Development in Degree Programmes*. Higher Education Academy, Physical Sciences Centre, University of Hull: 2010.
- (28) White, K. N.; Vincent-Layton, K.; Villarreal, B. Equitable and Inclusive Practices Designed to Reduce Equity Gaps in Undergraduate Chemistry Courses. *J. Chem. Educ.* **2021**, *98* (2), 330–339, 10.1021/acs.jchemed.0c01094.
- (29) Williams, D. P.; Karim, K. Inspirational Chemists: A Student Conference Activity to Raise Awareness of Diversity and Inclusion in the Chemical Sciences. *J. Chem. Educ.* **2020**, *97* (11), 4039–4043, 10.1021/acs.jchemed.0c00462.
- (30) Department of Chemistry, University of York. Athena SWAN Department Application, Gold Award, November 2018. <https://www.york.ac.uk/media/research/documents/athenaswan/York-Chemistry-Gold%202018%20for%20publication.pdf> (accessed 2021-09-10).
- (31) Department of Chemistry, University of York. Chemistry@York's EDI Training Videos YouTube Playlist. https://www.youtube.com/playlist?list=PLC6kVFgWcYKs-sn54yW8x-P0A_BtaGEHa (accessed 2021-09-10).
- (32) Smith, D. K. Designing Skilful Chemists. *Educ. Chem.* **2016**, *53* (4), 18–21.
- (33) Mehta, G.; Yam, V. W. W.; Krief, A.; Hopf, H.; Matlin, S. A. The Chemical Sciences and Equality, Diversity, and Inclusion. *Angew. Chem. Int. Ed.* **2018**, *57* (45), 14690–14698, <https://doi.org/10.1002/anie.201802038>.
- (34) Mertz, P. S.; Neiles, K. Y. Scaffolding Career Skills into the Undergraduate Curriculum Utilizing a Backward Design Approach. In *Integrating Professional Skills into Undergraduate Chemistry Curricula*, Neiles, K. Y., Mertz, P. S., Fair, J., Eds.: American Chemical Society: Washington, DC, 2020; Chapter 4, pp 43–55; DOI: 10.1021/bk-2020-1365.ch004.

-
- (35) GSK. GSK Announces Gender and Diversity Aspirational Targets to Increase Representation at Senior Levels. https://www.gsk.com/en-gb/media/press-releases/gsk-announces-gender-and-diversity-aspirational-targets-to-increase-representation-at-senior-levels/?mc_cid=01646f1d58&mc_eid=740fba0e77 (accessed 2021-09-10).
- (36) AstraZeneca. AstraZeneca Inclusion and Diversity page, <https://www.astrazeneca.com/sustainability/ethics-and-transparency/inclusion-and-diversity.html> (accessed 2021-09-10).
- (37) Sarju, J.; Jones, L. Improving the Equity of Undergraduate Practical Laboratory Chemistry: Incorporating Inclusive Teaching and Accessibility Awareness into Chemistry Graduate Teaching Assistant Training. *J. Chem. Educ.*; submitted for publication.
- (38) van Buuren, A.; Yaseen, W.; Veinot, P.; Mylopoulos, M.; Law, M. Later Is Too Late: Exploring Student Experiences of Diversity and Inclusion in Medical School Orientation. *Medical Teacher* **2021**, 1–15, 10.1080/0142159X.2021.1874326.
- (39) Moss-Racusin, C. A.; Dovidio, J. F.; Brescoll, V. L.; Graham, M. J.; Handelsman, J. Science Faculty's Subtle Gender Biases Favor Male Students. *Proc. Natl. Acad. Sci. Unit. States Am.* **2012**, *109* (41), 16474, 10.1073/pnas.1211286109.
- (40) Project Implicit. Harvard Implicit Association Test. <https://implicit.harvard.edu/implicit/takeatest.html> (accessed 2021-09-10).
- (41) National Academies of Sciences, Engineering, and Medicine. Educational Interventions to Improve Recruitment and Retention. In *Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine: Opening Doors*; The National Academies Press: Washington, DC, 2020.
- (42) Meyer, A.; Rose, D. H.; Gordon, D. T. Universal design for learning: Theory and practice. CAST Professional Publishing: 2014.
- (43) Aish, N.; Asare, P.; Miskioğlu, E. E. In *People Like Me: Providing Relatable and Realistic Role Models for Underrepresented Minorities in STEM to Increase Their Motivation and Likelihood of Success*, 2018 IEEE Integrated STEM Education Conference (ISEC), March 2018; pp 83–89.
- (44) Knezz, S. N. Drawing a New Scientist: Why I Come Out to My Chemistry Class. *J. Chem. Educ.* **2019**, *96* (5), 827–829, 10.1021/acs.jchemed.8b00846.
- (45) Khunti, K.; Routen, A.; Pareek, M.; Treweek, S.; Platt, L. The Language of Ethnicity. *BMJ* **2020**, *371*, m4493, 10.1136/bmj.m4493.
- (46) Whitehead, J. Motives for Higher Education: A Study of Intrinsic and Extrinsic Motivation in Relation to Academic Attainment. *Cambridge Journal of Education* **1984**, *14* (2), 26–34; DOI: 10.1080/0305764840140204.

-
- (47) Wang, L. Making Invisible Work in STEM More Visible. *Chem. Eng. News* **2019**, 97 (26); <https://cen.acs.org/careers/diversity/Making-invisible-work-STEM-visible/97/i26> (accessed 2021-09-10).
- (48) Jimenez, M. F.; Laverty, T. M.; Bombaci, S. P.; Wilkins, K.; Bennett, D. E.; Pejchar, L. Underrepresented Faculty Play a Disproportionate Role in Advancing Diversity and Inclusion. *Nature Ecology & Evolution* **2019**, 3 (7), 1030-1033, 10.1038/s41559-019-0911-5.
- (49) University of York. A University for Public Good, A Strategic Vision for the University of York to 2030. <https://features.york.ac.uk/vision-for-york/> (accessed 2021-09-10).

Supporting information: Full outline of online EDI workshop, videos, resources and extension activities.

Below is a full transcript of the online EDI training made available via York's virtual learning environment, including all of the text and links to videos and resources. The embedded recordings made for the session have been made available on YouTube and can be accessed via [this YouTube playlist](#) or using the links below.

Part 1: Introduction

(Prof Caroline Dessent, Chair of Departmental Equality and Diversity and Inclusion Committee)

Welcome to this session on Equality and Diversity.

In this session, you will find a series of videos and audio recordings of York Chemistry staff talking about different aspects of diversity, along with some links to resources and extension activities.

1. Watch the recordings (~50 mins)
2. Look at the links to resources.
3. Watch the Royal Society 'Understanding Unconscious Bias' Video and then complete the Harvard implicit association test activity, each test should take 10-15 mins to complete (Part 7).
4. Join the live Q&A session on Zoom at 09:00 Thursday Week 9 (26th Nov)

[Join Zoom Meeting](#) ID: XXXXXXXXXXXX, Password: XXXXXX



<https://youtu.be/D8mj32GSeEM>

Part 2: Ethnicity and race equality

(Dr Avtar Matharu)

Note the heading of this section was left intentionally blank to avoid giving away a key message of the video too early. A slightly abridged version of the recording used in the session has been made available.



<https://youtu.be/xtsaY97FBKU>

Resources: Ethnicity and race equality

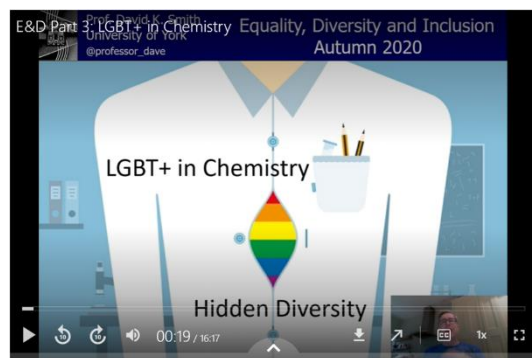
York University Let's talk about race and racism

<https://www.york.ac.uk/about/equality/talk-about-race/>

Chemistry world article: [UK chemistry pipeline loses almost all of its Black, Asian and other ethnic minority chemists after undergraduate studies](#)

Part 3: LGBT+ in chemistry

(Prof David Smith)



https://youtu.be/_zVIEEoXBUw

Resources: LGBTQ+

Royal Society of Chemistry's new LGBT+ Toolkit has a whole host of resources including guides on knowing your rights, trans inclusion, international mobility and guides for employers and allies. <https://www.rsc.org/new-perspectives/talent/inclusion-and-diversity/resources/lgbt-toolkit/>

Exploring the workplace for LGBT+ physical scientists report (PDF)

https://www.rsc.org/globalassets/04-campaigning-outreach/campaigning/lgbt-report/lgbt-report_web.pdf

The LGBTQ+ STEMinar: is a multidisciplinary conference designed for people who work or study in STEM subjects. The next LGBTQ+ STEMinar will be hosted by Wadham College, University of Oxford on 8 January 2021. Registration is open now (Nov 2020) and we encourage LGBTQ+ students to register and

attend online if you can. <https://lgbtstem.wordpress.com/lgbtq-steminar-2021/>
Registration deadline: Monday 4 January 2021

Part 4: Disability inclusion (Dr Julia Sarju, Disability Officer)



<https://youtu.be/u48YnQgtRt4>

Resources: Disability inclusion

Wanda Diaz Merced TED Talk: [How a blind astronomer learnt to listen to the stars](#)

Stella Young TED Talk: [“I’m not your inspiration”](#)

[Video from University of York disability services](#)

Disability Rights Fact Sheets: [Understanding the Equality Act: information for disabled students](#)

[Royal Society: Celebrating Disabled Scientists](#)

Part 5: Gender equality

Wellcome Trust Sanger Institute Sex in Science talk series: Paul Walton from the University of York - Equality for Women in Science: Now, Sometime, Never?
(external resource)



<https://youtu.be/jjjHVUJPUHM> (external resource)

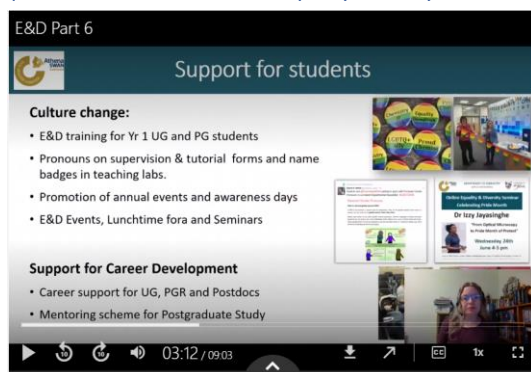
Gender Equality:

RSC Breaking the barriers report:

[RSC gender equality report \(PDF\)](#)

RSC Diversity landscape of the chemical sciences [report by the Royal Society of Chemistry \(PDF\)](#)

Part 6: EDI work of the department and unconscious bias (Dr Leonie Jones, Employability and Diversity Officer)



<https://youtu.be/EsFY3c8vfo0>

Part 7: Understanding unconscious (implicit) bias

We all have unconscious biases. They are learned stereotypes that are automatic, unintentional, deeply engrained within our beliefs, universal, and have the ability to affect our behaviour. For example, if you're stuck in a car park with a flat tyre, chances are you'd be most likely to approach a man, rather than a woman, if you needed assistance in changing it.

The following animation produced by the Royal Society introduces the key concepts of unconscious bias and how to mitigate against it.



<https://youtu.be/dVp9Z5k0dEE> (external resource)

After you have watched the video, you should complete the activity below on the Harvard Implicit Association Test (IAT) below.

Activity: Harvard implicit association test

The Harvard Implicit association test (IAT) is a well-known tool which looks at the strength of associations between concepts (e.g., black people, gay people) and evaluations (e.g., good, bad) or stereotypes (e.g., athletic, clumsy). The IAT attempts to measure attitude and beliefs that people may be unaware of or unwilling to report (i.e. unconscious bias). The IAT may be especially interesting if it shows that you have an implicit (unconscious) attitude that you did not know about.

Note: We've included the IAT test here as it provides an interactive tool for engaging with the topic of unconscious bias.

If your results surprise you, you may like to retake it, and see what you get a second time.

Your results are private to you, and are not shared with us in the department or anyone else.

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1. Go to the [Harvard Implicit Association Test \(IAT\) website](https://implicit.harvard.edu/implicit/takeatest.html)
 2. Select '[Take a Test](#)' and click 'I wish to proceed' to Complete an Implicit Association Test (IAT)
 3. Choose either the '**Gender-Science**' and/or the **Race ('Black - White')** Implicit association tests. Each test should take about 10 minutes to complete.
 4. You will be asked to sort words into groups as fast as you can plus some questions about your beliefs, attitudes, and opinions, and some demographic questions.
 5. At the end, you will receive your IAT result along with information about what it means.

<https://implicit.harvard.edu/implicit/takeatest.html>

As the Harvard disclaimer suggests, not all researchers are in agreement on the value of the IAT, or on its relevance and significance in terms of actual behaviour. You can read more here:

<https://www.vox.com/identities/2017/3/7/14637626/implicit-association-test-racism>

Part 8: Extension activities

Equality Diversity and Inclusion Lectures at the Department of Chemistry, University Of York, UK

If you would like to know more about equality diversion and inclusion, you can watch some of our Equality and Diversity Beacon Lectures on a range of topics:

Prof Carolyn Bertozzi, Key Note Public Lecture - Celebrating 10 years of Chemistry Athena SWAN Gold
['The long Game of STEM Diversification'](#)

Dr Izzy Jayasinghe, UKRI Future Leader Fellow, University of Sheffield,
['From optical microscopy to Pride Month of protest'](#) [Not currently externally available]

Dr Donald Palmer, Royal Veterinary College, London
['From Windrush to the Royal Veterinary College and Founding the Reach Society – a winding journey to success'](#)
[Not currently externally available]

Royal Society of Chemistry Webinars: Building a better chemistry culture

The latest Royal Society of Chemistry 'Building a better chemistry culture' webinars are now all available online. The series has covered kindness, tackling bullying & harassment, managing change & isolation as well as tips for flexible working and lots more. ['Building a better chemistry culture' webinars](#)