

The DiveIn Vision

Diversity drives Innovation (*DiveIn*). Our vision is to invert the conventional Centre for Doctoral Training (CDT) model by prioritising the diversity of our cohorts of postgraduate research students (PGRs) rather than coalescing around a restrictive scientific theme. By putting diversity at the centre of our recruitment, training, and delivery programme, **we will foster innovation and scientific excellence** across the four EPSRC mission-driven priorities areas: Net Zero, AI, Healthcare, and Quantum, and beyond; and change the engineering and physical sciences (E&PS) research and innovation landscape in the UK. Park *et al.* affirm in a 2023 *Nature* article that “[p]apers and patents are becoming less disruptive over time”¹. The range of work scientists and inventors capitalise on has narrowed. While interdisciplinarity has long been held as central to innovation, the scientific community has in fact become more siloed. Traditional approaches to CDTs risk exacerbating this phenomenon by favouring consolidation in a field over disruption. Evidence shows that diverse talents are more likely to bring a fresh perspective to scientific problems², and it is well established that diverse teams are more innovative³ and better at problem-solving⁴. Hence there is an **evident and compelling case for building CDTs around diversity rather than around scientific topics**. Here, diversity must be considered in the broadest terms: diversity of fields, thoughts, background, and demographics; including and even favouring groups that have traditionally been marginalised. By ensuring diversity permeates across all CDT stakeholders – PGRs, supervisors, management teams, partners, and mentors – we will enable innovation and excellence in both science and CDT delivery. Understanding and breaking down the varied barriers faced by a diverse community will be tackled by adopting evidence-based best practice, drawing on our own experience and published literature. Our *Theory of Change* roadmap (Fig 1) captures how we will reach our outcomes and impacts across the dimensions of research, people, economy, and landscape. We will carry out thorough and periodical evaluation drawing on quantitative and qualitative data so that our practices are responsive. By expressly validating the direct pathway from diversity to scientific excellence, we intend to demonstrate that some CDT provision should be reserved for an inverted delivery model.

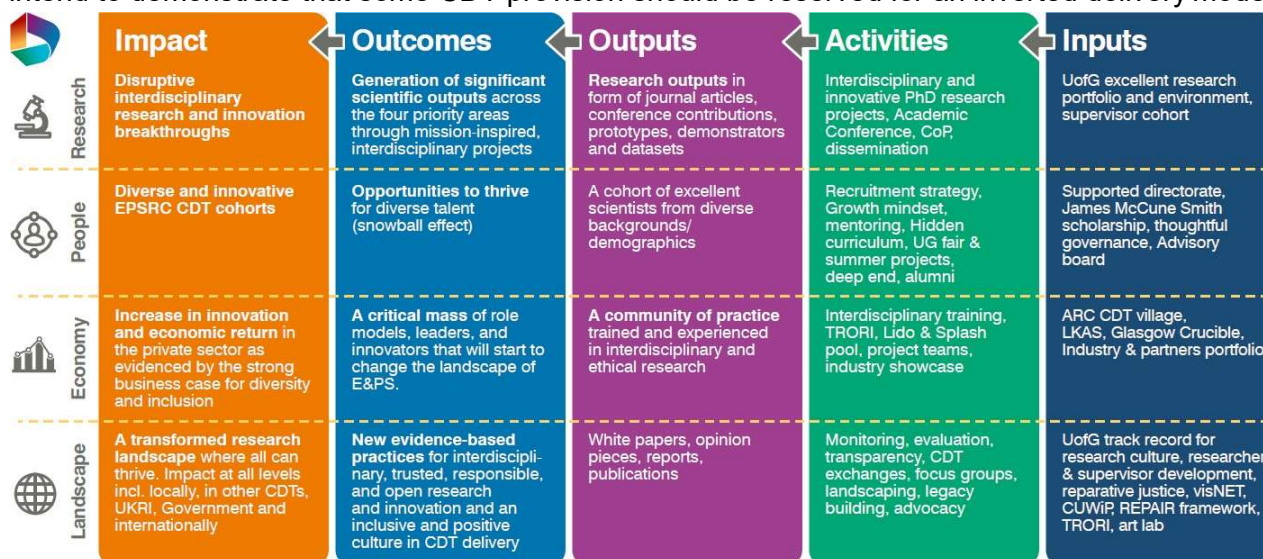


Fig 1: Theory of Change roadmap starting at inputs and leading to outcomes and impact of DiveIn.

The Need for an Innovative, Inverted CDT Approach

In 2021, UKRI took a significant step by consolidating its efforts concerning people, culture, and talent into a unified portfolio⁵. This strategic move was undertaken with a focus on achieving four key outcomes, each of which is critical in shaping the landscape of research and innovation: (i) *Talented people with the right skills and opportunities*, (ii) *Shared values that enable a full spectrum of people and ideas to thrive and to deliver excellent research and innovation*, (iii) *Frameworks that encourage positive and productive behaviours*, and (iv) *Engagement that inspires participation and a sense of shared endeavour*. Formalising this integrated approach acknowledges the symbiotic relationship between a diverse talent pool and a vibrant research culture encompassing behaviours, values, and norms within research communities⁶, a synergy which, in turn, paves the way for groundbreaking research and disruptive innovations. Meanwhile, the former Department for Business, Energy, and Industrial Strategy (BEIS) *R&D People and Culture Strategy* emphasises the importance of

interdisciplinary approaches, commits to equipping researchers with skills extending beyond their disciplinary boundaries, and recognises that researchers skilled at tackling challenge-led interdisciplinary research are a critical component of research and innovation (R&I)⁷.

The sector, therefore, has an agreed vision of the direction towards which the research landscape should strive, based on academic research that systematically shows that **success in innovation, positive research culture and challenge-led interdisciplinary research is supported and enhanced by diverse teams**⁸⁻¹⁰. Doctoral training has a crucial role to play in building this landscape: institutions that embody positive research culture and encourage mission-driven research are more likely to attract and retain diverse talents^{11,12}. In response, we have formulated the *DiveIn* inverted delivery model, where we will train our researchers in an environment that supports a diverse, innovative, and interdisciplinary research culture, to bring these qualities into their future careers, and lead to improved participation, well-being and economic success.

The case for making postgraduate research more attractive, relevant, and accessible to a wider pool more representative of the population has been clearly articulated in both the *UK R&D Roadmap* (former BEIS, 2020)¹³ and the *People and Culture Strategy*. Barriers to accessing doctoral education include financial constraints, undergraduate (UG) awarding gaps, criteria for recruitment, awareness (or lack thereof) of the research environment, a lack of visible role models and mentors, and poor reputation of the research culture^{14,15}. These factors are heightened for marginalised and minority groups, with different groups experiencing different barriers, compounded by intersectionality¹⁶. Compared to their representation at UG level, female, disabled, and Black, Asian and minority ethnic students are systematically underrepresented at the PGR level¹⁷. Within these communities lies significant untapped talent which can be accessed by offering appropriately tailored initiatives: the University of Glasgow (UofG) James McCune Smith (JMS) Scholarship for UK-based Black PGRs received >700 expressions of interest for 10 scholarships in 2022. Such schemes could address the shortfall of 173,000 skilled workers across the Science, Technology and Engineering and Maths (STEM) sector reported by the Institution of Engineering and Technology¹⁸. Retention during the PhD and beyond is also affected by financial insecurities and precarity, poor mental wellbeing, feelings of institutional exclusion, and inequitable access to the “hidden curriculum”^{17,19}, with the LGBTQ+ community disproportionately affected by harassment and othering^{20,21}. CDTs represent a significant proportion of EPSRC’s PhD provision; however, their alignment with the sector vision of the future of R&I, or how they can tackle barriers to diverse recruitment and retention in STEM, are not yet at the heart of their ethos and design. In fact, justice, equity, diversity, and inclusion (JEDI), responsible research and innovation, support for student wellbeing and trusted research are not assessed for funding despite their essential importance for generating a positive research culture.

Our delivery strategy is markedly different from convention: of the 123 invited full proposals, *DiveIn* is the only CDT that focusses on the diversity of the PhD cohorts and is not tailored to a specific scientific area, thus offering opportunities to support a wider range of projects and supervisors. In a survey we conducted locally with supervisors, CDTs were seen as providing the resources to support successful PhD projects. Most of the respondents, however, had not previously been involved with a CDT and the most common reasons were 1) the lack of CDTs in their fields, 2) their research was too interdisciplinary/broad, and 3) a “closed shop” perception associated with CDTs. We believe there is strong demand for a people and talent focused CDT and, with *DiveIn*, will address this gap, while providing evidence for future funding allocations.

“The calibre of students successfully getting into a CDT is now so high that it is highly exclusionary for those from widening participation backgrounds. My [WP] students [funded through] non-CDT funding streams have gone onto some excellent careers in government agencies in relevant fields.”

Prof Larissa Naylor, Geosciences, UofG

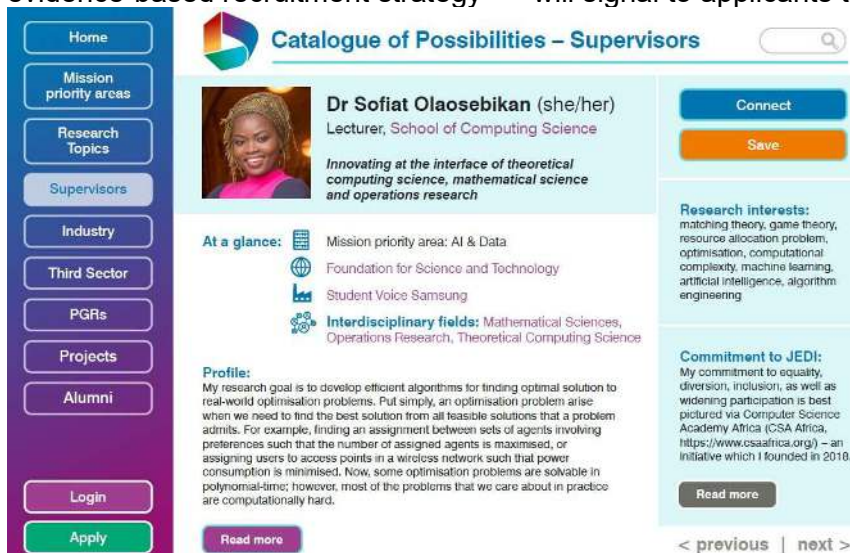
A Diversity-Driven Innovative Model for CDT Delivery

Our radical inverted model requires new thinking and an innovative roadmap. For this reason, single site delivery at UofG has been selected to streamline delivery. We will enhance engagement, recruitment, and support within a diverse PGR, supervisor, and partner community by championing interdisciplinarity within research teams, and thereby encouraging innovative and disruptive projects. We shall foster an environment where **interdisciplinary research** becomes an accessible reality, mirroring the ideal of mission-driven, open, and trustworthy research practices, supported by a vibrant network of external partners and equitable team dynamics. Our model underscores the

indivisibility of diversity, positive research culture, and excellence in interdisciplinary R&I, echoing UKRI's shift in amalgamating people, culture, and talent. We are proposing a transformative PhD experience underpinned by three pillars that make it easy and enthusing for diverse talent to **CONNECT** to the R&I communities, ensure that all PGRs feel that they **BELONG** and succeed in the academic environment, and enable all to **THRIVE** during the PhD and beyond.

1. CONNECT

The **CONNECT** pillar encompasses strategic approaches to link potential applicants, PGRs, the wider *DiveIn* community, and the broader R&I sector. It starts by fostering the recruitment of truly diverse cohorts of researchers, key to ensuring the scientific innovation and excellence that will enable the success of *DiveIn* and permeates through the PhD journey by constantly offering opportunities for new connections. The key theme bolstering activities in this pillar is **trust**: our evidence-based recruitment strategy^{22,23} will signal to applicants that *DiveIn* is a safe and actively



empowering space for all researchers, with specific consideration and support for those who do not feel included.

Catalogue of Possibilities (CoP). Our online CoP will be *DiveIn*'s mechanism to connect people, projects, and opportunities. The CoP (**Fig 2**) captures the imagination of potential applicants, supervisors, and partners, unlocks ideas and inspiration for new research directions, and builds credibility and trust for diverse talent to put themselves forward. Our ethos will be highlighted alongside our

Fig 2: CoP- Supervisor profile

programme for student personal development and belonging, including varied communications (blogs, vlogs) from our cohorts. The CoP showcases the profiles of our diverse community of supervisors across the seven Schools of the College of Science and Engineering (CoSE) and beyond at UofG, industrial partners and, with time, current PGRs and alumni and their work and aspirations around the four EPSRC mission-driven priority areas. It will showcase UofG's research beacons and world-leading research to complement *DiveIn*'s relevant research projects, activities and scientific challenges. Information on our supported application process will be provided alongside our commitment and track record in JEDI, our code-of-conduct for a safe and inclusive working environment, and the outputs of our regular evaluation exercises. We will be transparent with the demographic statistics of PGRs, PDRAs, and academic staff in CoSE. The CoP will be a vibrant platform featuring research activities and opportunities to encourage new connections.

Recruitment Strategy. Strategic partnerships with established networks (e.g., Blackett Lab Family, PrideinSTEM, Wise, EDGE Summer program, Piscopia Initiative, Mathematically Gifted & Black) for targeted advertisement will help encourage and support applicants from a broad range of backgrounds to achieve our goals for diverse recruitment. While we will focus on increasing application rates from marginalised and minority groups, the process will be fair, transparent, and equitable to ensure **diversity in the broadest possible sense, i.e., also inclusive of non-marginalised groups**. The following tools will ensure strong recruitment across all sectors. (i) **Pipeline Building.** The leaky pipeline phenomenon is well-established across multiple disciplines, leading to a loss of talent from underrepresented demographics²⁴. To tackle this at the UG/PGR interface, we will run capacity building activities ringfenced for UG students from marginalised and minority groups. Following from our experience with the successful TIGERs in STEM webinar series and the CUWiP conference, we will run a **yearly capacity building event** where 20 students, identified by our strategic partners, will receive communication training and take part in a mini conference, mentored by *DiveIn* PGRs. We will also offer **paid UG summer placements** within the *DiveIn* research community. Together, these will develop confidence, skills and belonging in prospective applicants and provide an avenue for the CDT to showcase its activities. It is essential

that we target those who would be unlikely to apply; these events will convince them that they can achieve a PhD, and therefore boost application numbers from diverse talent. (ii) *Leveraging Networks*. As part of our self-reflective delivery philosophy, we will run **annual focus groups** for UG students in collaboration with the UofG Amplify programme (see below) to better understand key barriers to PhD entry that different groups face and allow us to position ourselves appropriately to target specific demographics if they are under-applying. (iii) *Offering Incentives*. Financial insecurity plays an important role in students' decisions to apply for a PhD, and significantly affects diversity in conventional programmes²⁵. In a scoping survey with our graduating students, 75% of respondents identified stipend enhancement as important/ very important when considering graduate studies. As such, **all stipends will be topped up by £4k p/a**, and all students will receive a laptop for their studies. In addition to training and travel packages, we have assigned a budget for additional support and will advertise the option of part-time and flexible studies. (iv) *Supported Applications*. Laborious, metric-driven application processes are proven to adversely affect women and minority groups. We will use an efficient, compact application process that focusses on key skills and personal motivation, influenced by the emergence of *Resume for Researchers* narrative CVs. Inspired by the UofG JMS Scholarships, we will offer a light touch **expression of interest** to support applicants through the process and ensure they do not disengage. Applications will be streamlined, and live info sessions and comprehensive guidance (including all assessment criteria, FAQs, and short videos) will be available on the CoP. To monitor scientific and demographic diversity, we will ask applicants to select specific mission-driven priority areas, highlight what topics they are passionate about and what inspiration they drew from the CoP, and provide a short personal statement covering their own perspectives and experiences in JEDI. (v) *Positive Interviews*. Candidates will be shortlisted based on anonymised ratings of individual questions by a diverse panel²⁶, then invited for online interviews where all questions will be made available in advance. UofG PGR feedback underlines how much candidates value the interview process. Besides its purpose of applicant selection, it allows candidates to assess that UofG is a supportive and welcoming environment, and a place they feel comfortable. (vi) *Transparent Outcomes*. To build trust with future applicants, we will publish statistics on application and success rates, including anonymised demographic information.

Annual Industry Showcase (AIS). One of two flagship annual events, the AIS, held in November, will underpin the CONNECT pillar by bringing together the whole *DiveIn* community of PGRs, alumni, supervisors, management committee, steering group and external partners. It will be a celebration of *DiveIn's* interdisciplinary problem-based projects; a chance to enthuse new partners and grow our community. The AIS will create opportunities for project collaboration, sponsorship and placements for early years PGRs, for impact generation for the later years, and for career planning for graduating PGRs and alumni, e.g., we will distribute short bios of attendant industry representatives to foster private conversations with PGRs, such as help with sector-specific CVs or overcoming obstacles. The AIS will be a vehicle to share, discuss and steer *DiveIn's* ethos, progress, evaluation, and future.

2. BELONG

The BELONG pillar transforms connections into collaborations, PGRs into excellent interdisciplinary researchers, and *DiveIn* members into a community with a sense of common journey. Evidence shows that a sense of belonging is essential to the retention of marginalised and minority researchers who are often faced with othering, victimising, and bullying^{27,28}. By nurturing varied collaborations, promoting ethical conduct, facilitating continuous learning, and offering mentoring and championing, we will create an ecosystem that fosters future-shaping research and enables all to thrive.

Mentoring and Sponsorship. Each PGR benefits from a robust support network, providing guidance, coaching, and championing to help them navigate challenges and seize opportunities. From facilitated workshops to informal interactions, mentoring and sponsorship empower PGRs to become successful researchers. An academic mentor guides the PGR through the academic landscape, offering expertise and insights from varied disciplines. An industrial/ external sponsor connects PGRs with real-world contexts and practical applications, broadening their horizons beyond academia. Peer mentoring groups create a safe space for knowledge sharing, skill development, and mutual support. The management committee and the international steering group protect the PhD journey through a formal review process and continuous championing.

Diving In. The period from September to December in Year A (**Fig 3**) sets the stage for interdisciplinary collaboration, personal growth, and transformative project development within the

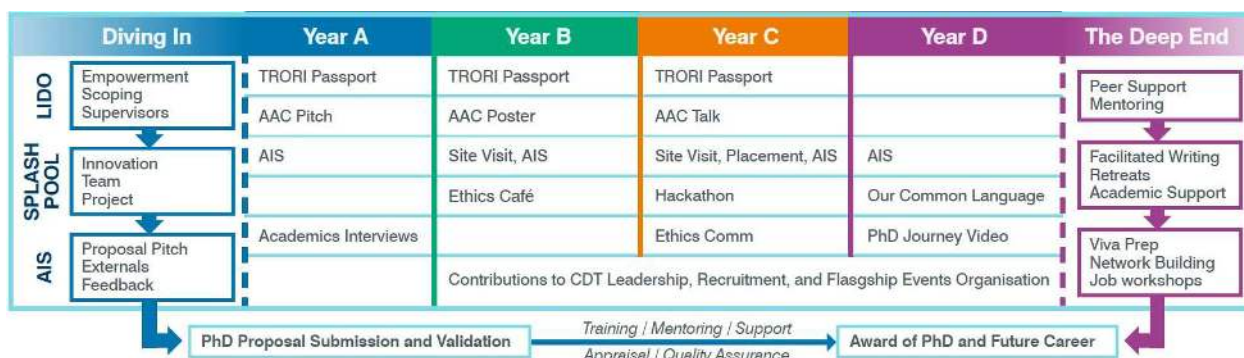


Fig 3: the DiveIn PhD journey

DiveIn ecosystem. In their first month, PGR-As (postgraduate researchers in Year A) have no supervisor, project or departmental affiliation. Accommodated in the vibrant **CDT village** located in the Mazumdar-Shaw Advanced Research Centre (ARC), PGR-As embark on their PhD journey under the care of the directorate, their cohort, and their peer-mentoring group. *Team and Project Building*. The process of forming interdisciplinary teams and projects is enabled through a series of events: the *Lido*, *Splash Pool*, and the *AIS*. **The Lido** (September) brings together PGR-As and potential supervisors (see below) for 3 days, in which PGR-As and academics (i) receive separate capability training to upskill them for building collaborative and interdisciplinary teams, and (ii) co-create a compelling set of problem statements rooted in their expertise, curiosity and aspiration. Following the *Lido*, a shortlist of supervisors is collaboratively agreed by the participants. **The Splash Pool** (September), held shortly after the *Lido*, provides a platform for PGR-As to explore collaboration with the shortlisted academic supervisors. Facilitated by **sandpit specialists** (Knowinnovation), invited interdisciplinary mentors and provocateurs, this 3-day event encourages open dialogue and the shaping of research projects with clear interdisciplinary focus poised to contribute meaningfully to mission-inspired themes. **Project teams** (1 PGR and 2+ supervisors) are formed and the PGR-As join the School of their primary supervisor in Month II for formal induction. At the **AIS**, PGR-As pitch their nascent projects. **External partners** can join the project teams and steer proposals. Proposal preparations continue and cohort-wide feedback sessions take place regularly until, by the end of Month IV, project teams submit their final proposals for validation by the Management Committee, who oversee feedback sessions, quality checks, and offer support to settle participants within the university and city, including introductions to homophilic communities. The Management Committee liaises with the CoSE Graduate School to facilitate seamless transition of PGRs into Schools to commence their PhD projects and their journey to scientific excellence.

Learning Framework. Our framework combines individual and cohort-level learning and development across 4 core dimensions, each designed as a longitudinal journey over 4 years with a mix of didactic, self-directed, empirical and peer learning²⁹⁻³¹. This model dedicates time to training, cohort building and other CDT activities without compromising the success of the PhD research or access to subject-specific learning in individual Schools. **Dimension 1: Interdisciplinarity**³². *DiveIn* prioritises interdisciplinary projects that transcend silos, solve real-world problems, engage external partners, and foster innovation beyond academia. The academic mentor will be distinct to the areas of specialism of the PGR to further train them to communicate outside of their discipline. The *CDT village* in the ARC and events like the **AIS** and **annual academic conference** (see below) foster collaboration and expose researchers to various fields and partners. In addition to didactic training and experiential learning, Year A will include an online lunchtime seminar series on successful interdisciplinary stories. PGR-Ds will organise an event for the *DiveIn* community, **Our common language: stories of understanding each other**, where they will each create a personal narrative (5-7 minutes) that highlights their interdisciplinary journey. **Dimension 2: TRORI.** Trusted, responsible, and open research and innovation (TRORI) are central to the *DiveIn*'s outcomes. Focus on ethics, openness, and responsible research promotes integrity, accountability, and inclusivity in research and innovation. PGRs will keep a TRORI passport, which will document their learning and its impact on their research journeys. PGRs attend annual **responsible research and innovation workshops** tailored to their increasing experience. A lunchtime seminar series covers topics like trusted research, data visualisation, and ethics in Year A, and decolonization of research, community science, equitable partnerships, and publishing in Year B. PGR-Bs organise **the Ethics Café**, with an invited plenary speaker and facilitated inter-cohort conversations while PGR-Cs collaboratively

craft a communication piece on TRORI topics. **Dimension 3: Growth mindset.** By nurturing the belief that skills and abilities can be developed through effort and learning, we empower researchers to overcome setbacks, explore uncharted territories, continuously refine their approaches³³ and eventually actively transform their environment. By creating an inclusive, healthy research environment, we can foster a growth mindset in our PGRs that is not a deficit model in which sole responsibility for attainment is placed on individuals³⁴. PGR-As undertake the **Power of Choice** programme, co-delivered with consultancy firm Korn Ferry, enabling participants to own their personal and professional development and unleash their potential. Consisting of classroom modules, group coaching and mentorship, this training deconstructs learned behaviours that have held back marginalised and minority groups in the past and is instrumental in supporting the *DiveIn* period and setting strong foundations for their PhD. To internalise the growth mindset, PGR-As organise interviews, to be published on the CoP, with established academics to discuss their career paths, challenges and growth. In Year B, a workshop explores the advantages of embracing setbacks within research and innovation. PGR-Cs scope, organise and participate in a **Hackathon**, addressing questions they will have selected on topics including the *DiveIn* training and ethos, challenges brought on by an external partner or a research challenge associated with the mission-driven themes. PGR-Ds create a video documenting their PhD journey and become active mentors to early stage PGRs. Between Years B and D, PGRs seize opportunities to enhance leadership through roles in CDT management, organising events, and contributing to recruitment. Finishing cohorts will be celebrated at the *AIS*, highlighting group and individual growth stories, and remain closely linked to the CDT as alumni and mentors. **Dimension 4: Formalising the hidden curriculum.** We provide equitable access to the unspoken knowledge and skills critical to navigating academia and research³⁵. By formalising non-academic skill development, we value the diverse strengths and experiences of our participants. Mentorship and championing are at the heart of this learning dimension. PGR-As are trained using the **REPAIRS model**¹⁹, co-designed by Dr Kay Guccione (on our steering group), for effective relationships with supervisors. PGR-Bs attend the **visNET workshop** to learn authentic and equitable community-building techniques. PGR-Cs embark on placements, tailored to their needs and aspirations, for practical experiences beyond their labs. Repeated communication training empowers PGRs to present their projects across diverse audiences. PGRs are supported in organising informal meetings with each other to practice communication skills, provide each other with feedback, act as discussants for each other and practice asking questions in a safe setting. With our Partners' Personal and Professional Development Programme (PPPDP), PGR-Bs and -Cs access a rich range of trainings to match their interest and enrich their skill set, e.g., policy engagement, community science, and entrepreneurship.

Annual Academic Conference (AAC). Our second annual flagship event, in May, brings the *DiveIn* academic community together to disseminate and discuss scientific research outputs. It will celebrate the research excellence demonstrated by diverse talent, their growth as researchers and collectively as a cohort, and showcase the innovative approaches of *DiveIn*. PGRs instilled with a sense of belonging will demonstrate their ability to communicate with an interdisciplinary audience. We will grow our academic family by inviting academics and PGRs from across UofG and other CDTs.

3. THRIVE

The THRIVE pillar encompasses the success of PGRs, supervisors, and the *DiveIn* model beyond the CDT lifetime. By championing the success of the project teams and actively supporting PGR-Ds, we ensure retention and completion. Foster professional development in PGRs and showcasing varied career pathways, while training supervisors to mentor diverse talent, ultimately produces **new evidence-based practices** for inclusive and positive CDT delivery. *DiveIn* will create a **critical mass of diverse PGRs, supervisors and partners**, and provide opportunities for diverse talent to thrive in their chosen career paths, form a community of practice, and profoundly change the STEM landscape. Maintaining strong alumni relations will safeguard *DiveIn*'s significant long-lasting impact.

Safeguarding Ambition and Risk. Considering the compounding effects of intersectionality, we will pay particular attention to retention and maximise efforts to enable all PGRs to successfully complete their PhDs. Holistic oversight of progress will be monitored by the management committee, based on quarterly assessments by the supervisors using light-touch PGR update reports and publications/presentations. To complement (and prepare PGRs for) UofG's annual progression process, annual internal appraisal occurs each May, enabling the CDT to evaluate whether teams and projects are thriving. Assessment will cover the PGR's presentation at the AAC, their TRORI passport, a progress

report, and the supervisors' self-reflection. Each project team is assigned two members of the steering group to follow progress across the PhD journey. Any major issue triggers an intervention from management with a bespoke remediation plan to support the team.

The Deep End. We recognise that supporting PGR-Ds with thesis writing to ensure timely submission, and preparing them for their impending career move, are pivotal for PGRs to thrive: *DiveIn* provides comprehensive assistance beyond UofG's standard resources for successful transition to the next phase of their professional journey. (i) *Community and Resources.* PGR-Ds will be aided in supporting themselves and each other, by co-creating a resource hub on the CoP; a repository of templates, information, and links, aiding thesis writing, career exploration, job searching, and transition preparation. (ii) *Thesis Writing and Submission.* Academic and alumni mentors will offer PGR-Ds writing consultations, guidance, and form peer review groups for personalised, constructive feedback³⁶. Facilitated writing retreats provide a conducive environment for focused thesis work. (iii) *Effective Applications.* A three-part job application lab will include workshops on (1) tailored CVs for diverse career trajectories with provision of exemplars to highlight relevant skills and experiences, (2) writing impactful cover letters and applications, and (3) interview preparation featuring mock sessions and strategies to tackle common interview situations.

Career Pathways. We will increase awareness of employment opportunities and career pathways, create robust networks of employers and end users, and provide mechanisms for engagement with all employment sectors, e.g. industry, government, academia and third sector. (i) *Placements.* PGR-Cs will undergo 3-6 months external mobility placements to give them direct experience of using their professional and transferable skills. Placement are prepared and secured by the end of Year B, and aligned to PGRs' training needs, research objectives, or career ambitions; there are no restrictions on the host type. We will provide support to approach and secure host organisations in industry, government, academia and third sector, including our project partners. (ii) *Site visits* immerse PGR-Bs and PGR-Cs in varied settings including R&D facilities (e.g., Clydespace, Scottish Water, National Physics Laboratory), employers and parliaments. This helps PGRs explore career opportunities in sectors they had not envisaged and exposes them to a wide range of career pathways. (iii) *External mentorship.* Every PGR will be matched with a non-academic mentor to provide a wider perspective on employment opportunities and career pathways outside academia. (iv) *Pathfinder talks* by PhD-holders from marginalised groups provide insights into varied careers.

Alumni and Role Models. Every graduate will update their profile in the CoP and keep their academic mentor throughout the lifetime of *DiveIn*. They will be invited back as mentors and participants in all cohort building events and supported in creating a network. For the first 4 years where CDT alumni are not yet available, we will engage with inspirational UofG graduates.

Supervisor Development. UofG offers an extensive programme for supervisor development: a Community of Practice, workshop series including topics such as *Being an anti-racist supervisor*, *Supervising stressed researchers*, *A supervisor's role in research integrity*, and The Auditorium Blog. *DiveIn* supervisors receive additional training, notably during the *Diving In* period, as well as training in mentorship and peer-mentoring facilitation. Supervisors will reflect annually on their experience of the *DiveIn* programme, providing plans for personal development and for changes in supervisory practice for the coming year, contributing to conversations on being a *DiveIn* supervisor at the AAC.

4. Delivery.

Delivery of *DiveIn* will be supported through robust management and governance structures (**Fig 4**).

CDT Directorate. *DiveIn* embeds diversity within its leadership; rather than one director, our CDT directorate comprises four co-chairs (0.25FTE each): Dr Caroline Müllenbroich (CM), Lecturer in Physics and Astronomy; Prof Caroline Gauchotte-Lindsay (CGL), Professor in Environmental Engineering and Chemistry; Prof Qammer Abbasi (QHA), Professor of Applied Electromagnetics and Sensing; and Prof Ross Forgan (RF), Professor of Supramolecular and Materials Chemistry. While CM is formally PI to meet Je-S restrictions, we all play an equal role in CDT management, sharing leadership through a biennial rotation to cover the four positions of director, with overall responsibility for the CDT, and leads for each of the three pillars, responsible for the operations within their remit. Rotation ensures a diversity of skills, fresh inputs for each role, and contributes to the seamless integration of the pillars. We have diversity in skills, background, and career stage, bringing different disciplinary viewpoints and personal experiences to CDT management, plus significant experience of managing and delivering large research programmes. Between us, the

directorate have: been PI or Col on >£40M of grants including ERC Starting Grant (RF: 677289) and members of significant collaborative interdisciplinary research programmes (QHA: EP/T021063/1; RF: EP/S009000/1; CGL: EP/V030515/1); supervised >40 PhD students; won >15 awards for research, teaching, and culture; produced >450 publications, books, and patents. We have also spearheaded major initiatives within the JEDI landscape, including the visNET EPSRC Inclusion Matters programme (CGL, EP/S012079/1); the CUWiP conference for UG women and nonbinary physicists (CM); attainment of Athena SWAN Bronze award as Chair of School of Chemistry EDI committee (RF); UofG Research Culture Awards (CGL, QHA). Our diversity of career stage and research perspectives, coupled with our experience in leading interdisciplinary research and JEDI initiatives, together enable us to propose and deliver fresh thinking to CDT management and to constantly question the status quo of conventional CDT arrangements. We have also embedded multiple layers of comprehensive governance, support and mentoring for the directorate to ensure effective CDT delivery. The directorate is supported in leadership by a CDT coordinator (professional services, 1FTE) and management mentors.

The Management Committee (MC) consists of the directorate, professional support, representatives of each School in CoSE – Chemistry, Physics & Astronomy, Engineering, Maths & Stats, Computing Science, Geographical & Earth Sciences, Scottish Universities Environmental Research Centre (SUERC) – 5 academic portfolio managers (4 mission-driven research themes plus problem-based research) and 5 elected PGR representatives. The CDT coordinator is supported by an administrator (1FTE), engagement coordinator (0.5FTE), training coordinator (0.2FTE), and events coordinator (0.5FTE). The MC will meet quarterly to assess performance with established key performance indicators (KPI), perform top level analysis of CDT strengths, weaknesses, opportunities, and threats and maintain a risk register. Informed by CDT governance, it will regularly review and tune practices.



Fig 4: CDT management structure

The CDT coordinator is supported by an administrator (1FTE), engagement coordinator (0.5FTE), training coordinator (0.2FTE), and events coordinator (0.5FTE). The MC will meet quarterly to assess performance with established key performance indicators (KPI), perform top level analysis of CDT strengths, weaknesses, opportunities, and threats and maintain a risk register. Informed by CDT governance, it will regularly review and tune practices.

CDT Governance. Two entities provide governance. UofG has appointed Prof Muhammad Imran, Dean of Graduate Studies and Prof Margaret Lucas, Dean of Research, as **management sponsors** for holistic oversight over all UofG CDTs. The sponsors will ensure balance between flexibility and appropriate risk management, and between control and freedom to innovate. Our **international steering group** (ISG) is currently comprised of 10 members including Prof Dame Jocelyn Bell Burnell (IOP, widening participation), Prof Ben Britton (British Columbia, LGBTQ+), Dr Kay Guccione (UofG, researcher development), Prof Muhammad Imran (UofG, Dean of Graduate Studies), Dr Izzy Jayasinghe (Sydney, LGBTQ+), Prof Sir David McMillan (Princeton, widening participation), Prof Robert Mokaya (Nottingham, Black & Global Majority), Carol Monaghan (Glasgow MP, policy), Prof Rachel Oliver (Cambridge, JEDI), and Prof Sheila Rowan (UofG, learned societies). An annually rotating chair will be drawn from these members who have been selected as their track records in JEDI, interdisciplinary work, trusted research and innovation are perfectly aligned with the CDT vision. We expect to grow the ISG as *DiveIn* matures. ISG and sponsors provide senior-level governance over KPIs, risk register and overall quality assurance (QA).

Management Mentors. The directorate is supported and mentored by senior UofG academics with extensive experience of running multi-million, multi-year investments including CDTs: Prof Daniele Faccio (Professor of Quantum Technologies), Prof Margaret Lucas (Regius Chair of Civil Engineering and Mechanics, management sponsor) and Prof Alessandro Vinciarelli (Professor of Computational Social Intelligence, SOCIAL CDT director, EP/S02266X/1).

DT Hub. Coordination and administrative roles for all UofG CDTs are clustered in the Doctoral Training Hub (DT Hub) further explained in our institutional letter of support. It ensures the sharing of best practice across all CDTs to create a high-quality service delivery to PGRs and directorate

and provides a supportive environment for *DiveIn*'s management and professional service staff.

Graduate School. The CoSE Graduate School will administer formal applications to UofG, academic offers, matriculation of students, transfer to the PhD programme, external examination and award. Local Schools' graduate processes handle progression, delivery of taught components and QA for teaching, progression and supervision of the PhD.

Monitoring, Quality Assurance, and Evaluation. Monitoring and evaluation are key to the innovative delivery model and are embedded at various levels from the outset to allow us to adapt our approaches over the lifetime of *DiveIn*. We will (i) assess our recruitment strategy by working with strategic recruitment partners to reach audiences who have not engaged and follow up with those who have submitted an expression of interest but not subsequently applied, (ii) monitor diversity after each application, shortlisting and PhD offer campaign, (iii) conduct focus groups with PGRs, supervisors and mentors, (iv) track career paths of our graduates during the lifetime of the CDT, and (v) evaluate our impact on external stakeholders and pathways to our intended legacy. Bonnie Slade, Professor of Adult Education for Social Change at UofG, will lead a longitudinal PhD study of *DiveIn*'s delivery model. Our processes will be evaluated twice a year by our governing bodies, the steering group and CDT sponsors.

The DiveIn Environment

UofG offers exciting world-leading research opportunities for *DiveIn*'s PGRs; its environment, facilities, and culture provide them with the means to excel in research and expand their networks.

Research Environment. UofG has a world class environment in all four EPSRC mission-driven research themes. (i) *Quantum: The Nano and Quantum World* is one of the six University-wide Research Beacons, and the ARC brings together researchers across the University under this theme. UofG is involved in all 4 EPSRC Quantum Technologies hubs and leads QuantIC (EP/T00097X/1, £24M). (ii) *Healthcare:* UofG's Research Beacons also include **One Health**, and **Precision Medicine & Chronic Diseases**. UofG is home to the *Living Laboratory for Precision Medicine*, a £90M investment (£38M from UKRI Strength in Places Fund) that offers a vibrant and supportive 'triple helix' ecosystem partnering academia, industry, and the NHS. The ARC hosts researchers under the *Technology Touching Life* theme, notably the interdisciplinary *Centre for the Cellular Microenvironment*. The *Centre for Medical and Industrial Ultrasonics* manages the *Ultrasurge* programme grant (EP/R045291/1, £8M). (iii) *Artificial Intelligence:* UofG's **Future Life** Research Beacon is underpinned by application of AI in Chemistry, Engineering, and Materials Science, while UofG's Centre for Data Science and AI facilitates world-changing, impactful, creative, collaborative, and ethical research in data science across sectors and partners. (iv) **Net Zero:** UofG's dedication to net zero is fuelled by the concept of a just transition as demonstrated by its *Addressing Inequalities* Research Beacon, the *Centre for Sustainable Solutions* and the ARC theme of *Global Sustainable Development*. UofG also leads large and prestigious interdisciplinary programmes, such as the NERC *Changing the Environment- Glasgow as a Living Lab Accelerating Novel Transformation* (NE/W005042/1, £10M), and the *Decentralised Water Technologies* programme grant (EP/V030515/1, £6M). Beyond the Research Beacons, the University is also dedicated to problem-based research and particularly the 17 United Nations' Sustainable Development Goals (SDGs). It ranked 13th globally in 2023 in the *Times Higher Education (THE)* Impact Rankings, a measure of the contribution of universities to the SDGs.

Experimental Infrastructure. Complementing extensive internal investment in campus expansion and its World-Leading Labs refurbishment programme, UofG has secured £7.2M of EPSRC strategic equipment funding since 2021, including: (i) a millimetre-wave and terahertz test cluster for 6G Communications (£2.6M, EP/W006448/1), (ii) high-resolution 3D X-ray tomography and X-Ray Photoelectron Spectroscopy (£2.7M EP/W02134X/1), and (iii) one of world's first commercial electron diffractometers (£1.9M, EP/X030083/1). These items sit within the CoSE analytical suite, established with EPSRC core equipment funding (£1.1M, EP/V034294/1) as a collaborative centre of interdisciplinary research excellence. UofG also hosts the *James Watt Nanofabrication Centre*, one of the leading centres of research and international collaboration in micro- and nano-fabrication technologies, housing >£35M of state-of-the-art fabrication and metrology equipment.

The Mazumdar-Shaw Advanced Research Centre. The newly built £118m ARC was designed to catalyse and advance collaboration, teamwork and innovation, drawing from all sectors and disciplines inside and outside UofG. The ARC will be the hub for *DiveIn* and provide dedicated space

level or higher while 40% are ECRs, including researchers new to PGR supervision, spanning the seven Schools of CoSE. Over 50% declared belonging to a marginalised or minority group. Cumulatively they have supervised over 400 PGRs with >90% completion within four years. They have strong awareness and commitment to interdisciplinary research, research culture and JEDI. They bring a portfolio of world-leading research in topics across the EPSRC remit such as intelligent technology for assisted living, metal-free organic electronics, new materials for joint communication and sensing, sustainable just transition, metaverse and digital twins, quantum-enhanced microscopy, environmental biotechnology for water for all, globally accessible smart labs and medicinal chemistry for a malaria-free world. They have, however, less experience in CDT engagement. We believe that our model allows us to tap into a uniquely wide and diverse supervisor pool and connect its members in unprecedented possibilities of interdisciplinary project teams.

External Partnerships. We aim to set a precedent for academia-industry collaboration, prioritising diversity and interdisciplinary teamwork, with a focus on investing in people rather than limited scientific projects. Our partners play various roles in contributing to the success of our PGRs and underpinning our interdisciplinary problem-based projects.

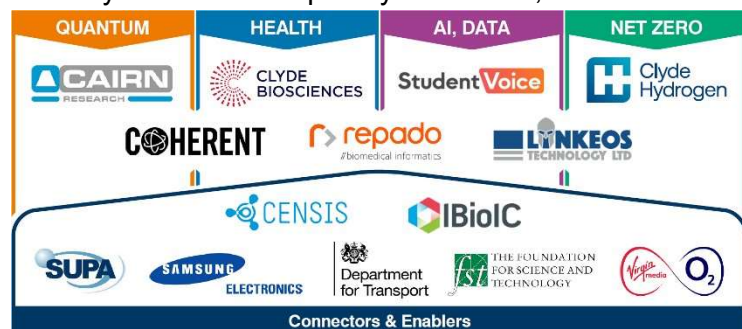


Fig 6: External partner network

(i) **Diversity of partnerships.** We have attracted a **portfolio of partners with strong diversity in sectors** and key technologies relevant to mission priority areas including AI, machine learning, responsible equitable data practices, microscopy and imaging, healthcare, life science, mass media telecommunications, non-destructive testing, inspection of nuclear waste, lasers, chemical sensing, quantum imaging, and government policy (Fig 6). Additional companies provide overarching perspectives and opportunities as **connectors and enablers**. Each organisation will be profiled on the CoP with links to related research fields, potential supervisors and existing projects as case studies.

(ii) **Meaningful contributions.** We have attracted co-funding of 5 half studentships totalling a cash contribution of £267k. Other partners are providing a rich offering of in-kind support totalling over £576k including: formulation of challenges faced by sectors; problem-driven research questions; hosting and collaborating on short projects; skilled employee time to provide mentorship, career guidance and advice; data sets; access to networks; event participation; hosting of company visits; equipment loans or access; consumables; commercial evaluation; translation to commercial exploitation; internships and placements for PGRs and UG (pipeline building); industry workshops; seminars; and training (e.g. The Foundation for Science and Technology and SUPA contribute to our PPPDR). By offering flexible, diverse support mechanisms we maximise engagement.

(iii) **Community Building.** For existing and new partners, the AIS will showcase opportunities of novel and interdisciplinary research and innovation enabled by a diverse pool of talent and ignite new problem-based collaborations. Partners will remain involved throughout the year through placements, company visits and by taking part in events such as the PGR hackathon as question setters, or the *Splash Pool* as provocateurs.

(iv) **Sustainable Growth.** Beyond the partners that have provided letters of support, we are already in discussions with companies that have been inspired by our mission, including Fraunhofer UK, National Physics Laboratory, L'Oréal and GSK. Our inverted delivery model breaks the familiar norm and will require a period of validation and adjustment. As we make a business case for diverse talent, external partners are expected to co-create projects in response to skills and affinity of the applicant pool. Our letters of support clearly indicate project partners have bought into the *DiveIn* ethos and hugely value the building of a diverse pipeline of research talent. Using the CoP, our connectors and our existing network, we will continue to grow the reach of *DiveIn* as our activities,

"I am the industrial supervisor of a PhD student at UofG. My lab at L'Oréal Research & Innovation works on biomechanical properties of hair, in particular very curly hair, to provide inclusive products for a diverse customer base. DiveIn is an exciting opportunity for us to be involved in a CDT due to its broad remit of mission-driven research and get access to researchers from all backgrounds trained on inclusive research."
Dr Elisa Caberlotto, Group Leader, Advanced Research, L'Oréal R&I.

outputs, impacts, alumni, and mission become publicised, supporting engagement with global players such as Deloitte, Barclays or McKinsey who have longstanding expertise in training and similarly value diverse talent.

Legacy Building and Advocacy

DiveIn's legacy, outlined in our *Theory of Change* (Fig 1), emerges through our groundbreaking delivery model. (i) *Local Influence*. Our impact is

already felt locally at UofG: CGL has been invited to contribute expertise to the UofG Research Planning and Strategy Committee. Organic dissemination pathways for PGRs and supervisors are enabled by the *CDT village*, while Research Culture and Researcher Development expertise are embedded in our steering group (Dr Guccione). (ii) *CDT Community*. Leveraging the geographical proximity of ~30 proposed CDTs led by institutes in northern UK, **CDT student exchange** partnerships will further engage other CDTs. Short, focused exchanges for PGRs facilitate scientific cross-pollination, networking, and sharing best practices in responsible research, innovation, JEDI, and interdisciplinary research. Dedicated **CDT delivery tracks** at our two annual flagship events, AIS and AAC, provide mechanisms to share our learnings and invite contributions and suggestions from other CDTs. (iii) *UKRI Advocacy*. Our unprecedented CDT delivery model positions us to advocate for innovation in CDT delivery at the national level, e.g., the UKRI EDI *Caucus* and the EPSRC EDI *Sharing Hub*, and for the implementation of novel methodologies to enhance diversity in other doctoral training schemes. **We envisage a future** where a percentage of CDTs adopts a similar delivery model to serve as “interstitial” CDTs offering research topics not covered by traditional CDTs. Geographically distributed at strategic locations throughout the UK, these CDTs would also serve as hubs for the development and dissemination of best JEDI practices in CDT delivery. As centres of excellence in their own rights, these CDTs would present opportunities for diverse talent to contribute to the UK powerhouse of R&I. (iv) *Parliamentary and Governmental Influence*. This sustained impact will influence national policy; we have already been sought out by the Department of Transport due to our innovative approach. Steering group member Carol Monaghan MP will advise on effective communication with government(s) through evidence for inquiries and white papers. (v) *International advocacy*. We will produce conference presentations, publications, and opinion pieces to drive lasting impact on PGR training globally. (vi) *Critical Mass*. Ultimately, the most compelling evidence for the impact and legacy of *DiveIn* will be the **creation of a critical mass of role models, leaders, and innovators that will change the landscape of E&PS**.

“We are delighted to be involved in such a timely and innovative approach to training the next generation of engineers and scientists. We are enthusiastic about the potential of this CDT to deliver world leading research and to help us engage with new students and researchers.”

Prof Chris Jackson, Director of Sustainable Geoscience, Jacobs Engineering Group

“We regard the development of a pipeline of policy-adept early career researchers with a diversity of backgrounds, perspectives, and experience as a crucial enabler for the development and delivery of innovative and effective future government policy.”

Prof Sarah Sharples, Chief Scientific Advisor, Dept for Transport.

References: 1. Park *et al. Nature* 613, 138 (2023). 2. Hofstra *et al. PNAS* 117, 9284 (2020). 3. Nathan *et al. Econ. Geogr.* 89, 367 (2013). 4. Hong *et al. PNAS* 101, 16385 (2004). 5. <https://www.ukri.org/blog/ukris-approach-to-people-culture-and-talent/>. 6. <https://royalsociety.org/topics-policy/projects/research-culture/>. 7. BEIS. *R&D People and Culture Strategy*(2021). 8. Powell. *Nature* 558, 19 (2018). 9. Aubert Bonn *et al. BMC Res. Notes* 15, 309 (2022). 10. Specht *et al. PLOS ONE* 17, e0278043 (2022). 11. Fox Tree *et al. Front. Sociol.* 6, 792198 (2022). 12. Zhang *et al. Scientometrics* 126, 8861 (2021). 13. BEIS. *UK Research and Development Roadmap*. (2020). 14. Royal Society. *Research Culture: Changing Expectations Conference Report*(2019). 15. Wellcome Trust. *What Researchers Think About The Culture They Work In*(2020). 16. Linder. University College London. (2020). 17. Panagiota *et al. Advanced HE*(2022). 18. IET. *Addressing the STEM skills shortage challenge*. (2021). 19. The Hidden Curriculum in Doctoral Education, Elliot *et al. Springer International Publishing* (2020). 20. Gibney. *Nature* 571, 16 (2019). 21. Cech *et al. Sci. Adv.* 7, eabe0933 (2021). 22. Fernando *et al. Nat. Geosci.* 16, 658 (2023). 23. STEM Change. *Transforming the Language of Exclusion and Bias in Recruitment*(2021). 24. Sheppard *et al. Ann. Am. Assoc. Geogr.* 113, 817 (2023). 25. Mattocks *et al. Eur. Polit. Sci.* 15, 476 (2016). 26. <https://eo-cdt.org/edi/recruitment-best-practices/>. 27. Fisher *et al. PLOS ONE* 14, e0209279 (2019). 28. visNET. *Warm communities create inclusive research environments*. (2021). 29. Gibson *et al. Res. Eval.* 28, 51 (2019). 30. Tang. *Front. Psychol.* 10, 2020 (2019). 31. Doles *et al. Front. Educ.* 8, 1063075 (2023). 32. Bosque-Pérez *et al. BioScience* 66, 477 (2016). 33. Davis. *NCID Currents* 1, 1 (2019). 34. Claro *et al. PNAS* 113, 8664 (2016). 35. Enders *et al. J. Clin. Transl. Sci.* 5, e203 (2021). 36. <https://theauditorium.blog/2023/08/28/the-continued-impact-of-thesis-mentoring/>.