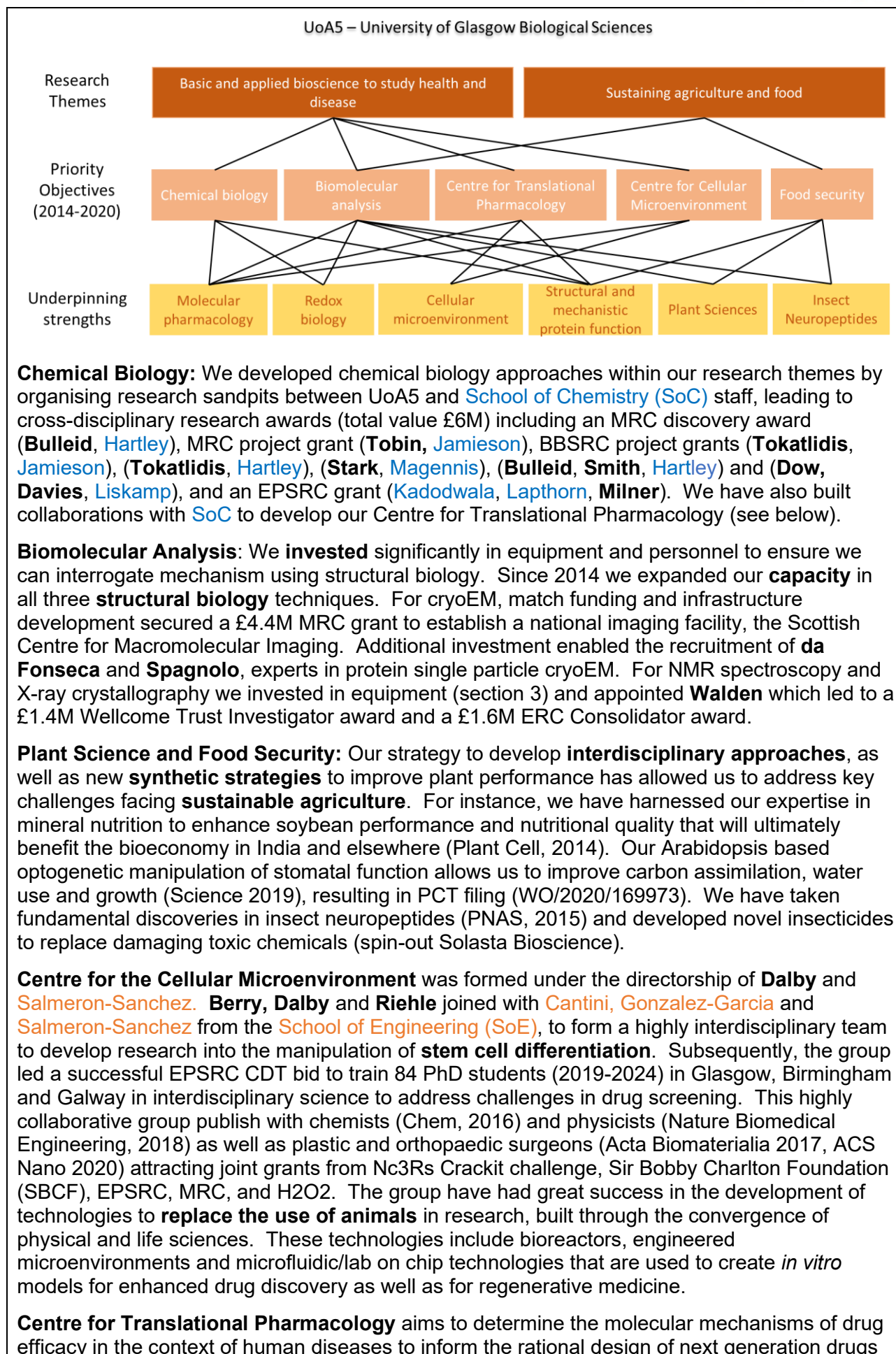


Institution: University of Glasgow
Unit of Assessment:UoA5
<p>1. Unit context and structure, research and impact strategy</p> <p>Unit structure.</p> <p>The College of Medical, Veterinary and Life Science is sub-divided into three Schools and seven Research Institutes. The staff returned to UoA5 are all affiliated to one Research Institute namely, the Institute of Molecular, Cell and Systems Biology (herein referred to as the Institute). Staff are line managed by the Director who reports to Head of College. The Director is supported by two Deputies, a Head of Professional Services, Chairs of Teaching, Research, Impact, Athena SWAN and Early Career Researcher committees who collectively form the Institute Management Group.</p> <p>Research context.</p> <p>Our Institute is divided into two overarching, cross-disciplinary themes, each with a translational portfolio:</p> <p>1) Basic and applied bioscience to study health and disease:</p> <p>Our expertise in molecular, biological, genetic, and biochemical approaches to cell and protein function; chemical biology; structural biology; and bioengineering is complemented through strong interdisciplinary links with the Schools of Chemistry, and Engineering. We have world-leading strengths in the following areas:</p> <ul style="list-style-type: none"> • molecular and translational pharmacology • structural and mechanistic studies of protein function • redox biology • cellular microenvironment <p>2) Sustaining agriculture and food:</p> <p>We are addressing the problems of sustainable agriculture by understanding how plants perceive, respond, and adapt to changes in their environment and by developing alternative ways to tackle pest control. We have exceptional strength in the following research areas:</p> <ul style="list-style-type: none"> • plant sciences – specifically light and temperature sensing in plants, and improving plant water use efficiency and stress tolerance • neuropeptides as novel pesticides <p>Research strategy 2014-2020.</p> <p>The 2014 submission detailed our plans to develop our research themes. Specifically, we aimed to:</p> <ul style="list-style-type: none"> • develop cross-disciplinary strengths in chemical biology impacting molecular and translational pharmacology, structural and mechanistic aspects of protein function, and redox biology • increase capacity in biomolecular analysis impacting all research areas • develop more applied areas of plant sciences such as food security impacting the sustaining agriculture and food research areas. <p>Establishing Centres for the Cellular Microenvironment and Translational Pharmacology was not in the 2014 submission, but it became a core strategy subsequently.</p>



and translate this to practice. The Centre has raised over £13.1M of external funding and has established productive external collaborations with both academic and industry partners. For example, the group collaborates with AstraZeneca, Eli Lilly and Sosei-Heptares to translate fundamental work to drug target evaluation thereby developing new therapeutics (Nature Chemical Biology, 2019, 2020). The group have uncovered novel targets for the treatment of malaria (Science, 2019) (spin-out Keltic Pharma) as well as type II diabetes and non-alcoholic steatohepatitis (spin-out Caldan Therapeutics) and asthma (Science Translational Medicine, 2020).

Success of our research strategy since 2014 is exemplified by:

- a transformation in our ability to **secure** research funding with an increase of research income from £5.3M to £9.4M (Ref 4b) between 2014 and 2019 and increased research income per member of staff from £155k to £275k/FTE/annum (note a drop in income in 2020 due to COVID19 lockdown).
- all staff submitted to UoA5 have held research funding over the period. 95% of staff currently have research grant funding.
- major awards from the BBSRC (LoLa and project grants), Wellcome Trust Collaborative and Investigator awards (4), ERC (consolidator award), MRC and EPSRC (programme grants), Leverhulme and SBCF, MRC (discovery grant), Cure Huntington Disease Initiative (CHDI) and EU (H2020 innovation and RIA grants).
- significant major postgraduate training grants from the EU (ITN x 2) and EPSRC (CDT).
- gaining recognition through election to prestigious societies: Academy of Medical Sciences FMedSci (**Milligan**), Royal Society of Edinburgh FRSE (**Christie, Dalby, Davies, Insall** and **Tokatlidis**) and EMBO (**Tokatlidis**).
- recruitment of 7 new independent research fellows with fellowships from the Royal Society (**Karnik**), UKRI (**Dobson**), Wellcome Trust (**Sanz**), and the University of Glasgow (UofG) Lord Kelvin Adam Smith (LKAS) scheme (**Bradley, Hudson, Colloms, Kaiserli**). Several of these recruits have now transitioned to academic posts within the unit (**Bradley, Colloms, Hudson, Kaiserli**).
- winning of major prizes including, the Biochemical Society Industrial-Academic Collaboration Award (**Dalby**), the Goodwin Prize (**Cogdell**), the JR Vane Medal for Pharmacology (**Milligan**), the Muscular Dystrophy UK Scientist of the Year and Huntington's Disease Society of America Researcher of the Year (**Monckton**), and Royal Society/Wolfson Merit awards (**Bulleid, Tobin, Tokatlidis**).

Strategy for future research.

Our future strategy aims to:

- further strengthen **interdisciplinary research** with a focus on **translational activity** within molecular and translational pharmacology, plant sciences, cell microenvironment and redox biology.
- develop more **large collaborative grants** between individuals within and outside UofG.

To facilitate these aims we will take advantage of the opportunities arising from the on-campus development of the Advanced Research Centre (section 3). To stimulate collaborative growth, we will fund fellowship opportunities, academic positions and PhD studentships focusing on our core strengths. Specifically:

- the **Centre for Translational Pharmacology (Tobin, Milligan, Bradley, Hudson)** will probe the function and drug targeting of G-protein Coupled Receptors (GPCRs) to define new therapeutics. Further, they will initiate new interdisciplinary collaborations with optical physicists to visualise brain architecture during neurodegenerative disease to

assess the efficacy of drugs. These efforts will harness our expanding partnerships with the biopharmaceutical sector.

- our world-leading **plant science** group (**Amtmann, Blatt, Christie, Jenkins, Jones, Kaiserli, Karnik, Milner**) will translate new discoveries on how abiotic factors impact photosynthetic productivity, growth, and yield into **modern crops** and **farming practices**. To achieve this aim, we will foster links with the James Hutton Institute and John Innes Centre.
- the **Centre for the Cellular Microenvironment (Berry, Dalby, Riehle)** with colleagues in **SoE**, will capitalise on its position as a top UK Centre for biomedical materials research. Recent successes in the treatment of bone fractures in veterinary patients will progress towards **human trials**. In addition, we will **translate** new discoveries in nerve regeneration to the clinic with our surgical and neuroscience collaborators.
- the **redox biology** grouping (**Bulleid, Dobson, Sanz, Tokatlidis**) will apply their expertise to diseases associated with altered mitochondrial function or cell stress. Our strategy will be to build on current collaborations with cardiovascular scientists at UofG (UoA1), particularly within BHF Centre of Excellence to **translate** fundamental discoveries into the clinic.

Strategy for driving impact - 2014 onwards.

Our aim since 2014 and going forward is to:

- nurture nascent impact cases while retaining academic excellence to develop new spin-out companies or to deliver societal change.

Our strategy was developed prior to the BBSRC Excellence with Impact competition (led by **Milligan**) where we were awarded top ranked University in 2016. To provide more impact focus we appointed an impact champion (**Dalby**). Our strategy to ensure long-term growth of impact is based on:

- focussed **engagement** and training for all staff including ECRs.
- targeted opportunity **audits** and **seed funding** to translate ideas to impact.

Focused engagement and training.

The impact champion engages with all UoA5 staff to organise outreach events – including Royal Society Summer Exhibition 2016 and 2018, research exhibition at the Glasgow Science Centre, Science Sundays at UofG, Glasgow Botanical Gardens Centenary Celebrations, Plant Explorathon, and Images on the Clyde. Our research staff, particularly ECRs, regularly win impact competitions within the College, e.g. impact in 60 seconds, 3-minute thesis and Impact with Excellence Twitter competition. This increase in 'grass roots' societal impact is aided by a social media committee that coordinates outreach activities. In addition, we embed impact training within our doctoral programmes. All our postgraduate students engage with industry and stakeholder partners. For example, both our ITNs involve companies developing novel anti-cancer therapies by targeting oncogenic GPCRs or green pesticides. In addition, the EPSRC-CDT includes 20 companies (plus a range of other stakeholders e.g. charity, funders, regulators etc.) that provide funding for student training as part of the programme.

We actively **fund societal impact**. Examples of this strategy having impact include the **Karnik** group who developed an interactive exhibit called Stomatoy to demonstrate plant light sensing to the public. Stomatoy was developed with BBSRC Impact Accelerator Award (IAA) funding providing professional advice to develop meaningful feedback. **Monckton** works with Huntington disease and myotonic dystrophy charities around the world, presenting to patient groups, and designing information packs. **Monckton** won the Muscular Dystrophy UK Scientist of the Year and Huntington's Disease Society of America Researcher of the Year as recognition of his research and dedication to public education.

Targeted opportunity audits and seed funding.

Since 2017, delivery of our translational impact strategy has been through the “Translational Research Initiative” (TRI, led by **Tobin**). The TRI brings together technology transfer and business development expertise alongside UofG’s investment partners providing access to translational funding of over £4.5M from MRC (Confidence in Concept (CiC), Proximity to Discovery (P2D)), BBSRC (Impact Accelerator Award (IAA)), Wellcome Trust (Translational Partnership (WT-TPA)) and UofG.

Through TRI, we fund “opportunity audits” with external entrepreneurial consultants to assess latent opportunities for translation. The audits provide targeted training, support for innovation, and opportunities to discuss research ideas with a panel of experts from industry. The approach has delivered several translational opportunities, supported through funding, business development expertise, and relevant training.

Below we highlight some examples of identified and funded opportunities since 2014 that will increase the impact of our research (see also section 3):

Milligan, with support from **Hudson**, spun-out a company (Caldan Therapeutics Limited, 2015) to commercialise research on GPCRs that are activated by long chain fatty acids. The research funding came from the BBSRC (total value £1.7m) and the Danish Agency for Science, Technology and Innovation (£2M). Initial investment of £4.55M was led by Epidarex Capital and a further £3.5M was raised in 2019/2020. The company is underpinned by a patent with identified drugs showing excellent efficacy in models of diet-induced obesity. This is one of our submitted UoA5 **impact cases**.

Dalby and Salmeron-Sanchez’s research on a cellular therapy for bone regeneration has undergone successful veterinary trials and has funding for a trial in humans. The team have funding from BBSRC, EPSRC and STFC IAAs and have BBSRC follow-on funding pathfinder awards (totalling £19k), and super follow-on fund grants (£782k) to investigate the market, overcome technical challenges and to scale-up cell manufacture.

Tobin is developing a novel approach to the treatment of malaria (Science, 2019). He obtained CiC funds (£73k) to develop lead molecules that target PfCLK3 forming part of the Medicines for Malaria Venture drug development pipeline. He has funding from the Bill and Melinda Gates Foundation (£90k) and MRC DPFS (£850k) to screen for novel anti-malarials. In addition, alternative screens funded through the European Lead Factory (£50k) will identify inhibitors of PfCLK3. Finally, a Japanese pharmaceutical consortium is funding drug screening with a local CRO partner (Bioascent) (£50k). **Tobin**, **Milligan** and **Jamieson (SoC)** founded Keltic Pharma (2020) with >£20M investment from the European Malaria Fund to exploit these and related opportunities (section 3).

Tokatlidis, has developed mitochondria targeting peptides for drug delivery with WT-TPA Early Concept Development funding (£20k), BBSRC and EPSRC IAA funding (£29k) for technical development and P2D funding (£10k) to fuel industrial engagement.

Milner is developing bacteriocin technology with support from PBL Technologies. He has patented his discovery and secured BBSRC IAA (£8k) and BBSRC Follow-on Funding (£202k) to characterise the stability, efficacy, resistance to, and methods of delivery of bacteriocins.

Strategy for interdisciplinary research

We actively support interdisciplinary research by:

- **Funding small workshops, sandpits, and seminars** bringing together multidisciplinary teams including researchers, and industry, with shared interests. The sandpits with **SoC** led to joint grant funding and workshops with **SoE** and various stakeholders led to the EPSRC CDT bringing a cross-disciplinary, multi-partner consortium together to deliver PGR training. Note that of the 86 papers selected for submission in this return, 14% have authors from different disciplines.
- **Providing leadership for the ARC**: the ARC is intrinsically cross-disciplinary, and **Tobin’s** directorship (see section 3) facilitates links with colleagues from Physics, **Chemistry** and **Engineering**.

- **Supporting early career researchers to bridge disciplinary boundaries** by providing fellowship and PGR scholarship opportunities for those interested in interdisciplinary research (called Lord Kelvin Adam Smith (LKAS) Awards). **Kaiserli, Colloms, Bradley** and **Hudson** were recruited to UofG through this fellowship scheme and UoA5 supervisors have been successful in securing 6 LKAS studentships in the assessment period.

Research integrity

UofG's approach to promoting a culture of research integrity is included as a case study for the UK Research Integrity Office and Royal Society. We have embedded a supportive culture providing training to help established staff, and ECRs, to better understand research integrity. We appointed an integrity champion (**Milligan**) who disseminates best practice through regular presentations and all staff complete an integrity training course. In addition, staff supervising ECRs undergo mandatory supervisor training which includes research integrity. UofG has developed a resource document 'Code of Good Practice in Research' available to all staff complementing the one-page UK Research Integrity Organisation checklist for key points of good practice.

Open research

Open publication and sharing data for re-use are key to improved integrity. The evidence of success in open access publishing is an increase in compliance from 36% in 2014 to 90% in 2019. 100% of UoA5 category A staff have an ORCID and staff are encouraged to use pre-publishing sites such as BioRxiv. Further, UoA5 staff are supported by the UofG library making raw data accessible upon publication. Data are curated for at least 10 years on UKRI compliant servers and a DOI is provided so that the data can be linked from the original article as well as from individual staff profiles.

2. People

Staffing structure.

The 36 category A staff (34.29FTE) within UoA5 comprise 21 Professors (15M/6F), 3 Readers (2M/1F), 9 Senior Lecturers (6M/3F), 1 Lecturer (M) and 2 Research Fellows (1M/1F). The UoA also comprises 50 post-doctoral researchers (PDRAs) and 75 PhD students. We have instigated several staffing strategies, which aim to enhance retention, create a vibrant research culture, and provide support towards career development enriching the working environment for all within the UoA. We obtained our Bronze (2017) and Silver (2020) Athena SWAN awards in recognition of our commitment to providing a supportive and flexible working environment, and progress towards achieving increasing inclusivity.

To support our staff, we employ 14 core-funded and 20 grant-funded technicians, and 7 administrative staff. The technical staff are either embedded in individual laboratories or within the core facilities providing support for specialised techniques such as imaging and biophysical characterisation of proteins. The administrative staff manage our research grant portfolio and give personal administration support.

Staffing strategy.

Our staffing strategy focuses on providing an environment that **attracts** and **retains** talent.

Recruitment:

Our strategy has been two-fold:

- making use of internal and external **fellowships** to attract individuals at the start of their career.

- actively recruiting **established** researchers to strategically important areas.

Our recruitment process is transparent with candidates, prior to interview, being invited to give a research presentation to all staff and students. Interview panels are inclusive, and all panel members undertake unconscious bias, and equality and diversity training.

Examples of our successful recruitment to specific areas of strength include:

Molecular pharmacology: we recruited **Tobin** to enable, with **Milligan**, the development of a **Centre for Translational Pharmacology**. They recruited **Hudson** and **Bradley** (via LKAS fellowship funding), who have since been promoted to core-funded Lecturer and Senior Lectureship positions, respectively. Tobin's recruitment led to a £4.2M Wellcome Trust Collaborative award; MRC grants of £2.1M, £1.9M, and £1.6M and BBSRC grants totalling £3.3M. The group has published several major papers since inception (Nature, 2016, 2020; J. Clin. Invest., 2017; Science, 2019; Science Trans. Medicine, 2020, Nature Chem. Biol., 2019; 2020, Nature Methods, 2019).

Structural and mechanistic studies of protein function: the recruitment of **Walden, da Fonseca** and **Spagnolo** has bolstered our structural biology capability in crystallography and cryoEM. In addition, we recruited **Kurz** to a Readership position. His research interests complement **Walden's**, extending our expertise into the role of ubiquitination in regulation of protein function. Several high-quality publications have emanated from this group (Nature, 2016; Cell, 2016; Nature Structural and Mol. Biol., 2017; Mol. Cell, 2019; Nature Chem. Biol., 2020).

Sustaining agriculture and food: To maintain our excellence in plant sciences we attracted **Karnik** and **Kaiserli** to join us with a Royal Society Research Fellowship and LKAS fellowship respectively. **Kaiserli** has since been appointed to Lecturer and then promoted to Senior Lecturer. We also recruited **Jones** to a Lectureship in plant sciences (now promoted to Senior Lecturer). These important appointments have generated BBSRC funding totalling £2M along with quality publications (Nature Plants, 2015; Plant Cell, 2015; Dev. Cell, 2015; PNAS, 2019).

Redox biology: **Dobson** and **Sanz** recently joined with a UKRI Future Leaders Fellowship and Wellcome Senior Research fellowship, respectively. They have complementary research interests in the role of oxidative stress and the gut microbiota in ageing. Their contribution to the grouping includes eight of our submitted publications (e.g. Cell Met., 2016; eLife, 2016; Nature, 2017; EMBO Mol. Med., 2018).

Induction: New staff (academic and ECR) undertake a well-established induction process, which is relevant to all staff and includes:

- a welcome meeting with the Director of Institute
- an induction pack with information on local and HR policies, Athena SWAN, social events, seminar series etc. as well as a dedicated induction webpage
- dedicated "Welcoming Champions", appointed in each building to provide introductions and facilitate settling in.

Our induction process is evaluated frequently using a feedback questionnaire and annual staff survey and is very highly regarded by all staff (83.3% satisfied, 2019).

Retention: Retention is a key strand to our staffing strategy and since 2014 we have focused on providing opportunities for development of existing staff to allow them to achieve their career ambitions within the Unit. Through careful **staff mentoring** we have attained a **92% success rate** for academic staff promotions with 11 being promoted over the period (seven Senior Lecturer, three to Professor). All female academic staff promotions have been successful (six) with three at Professorial level.

Over the same period, we have a **90% success rate** for our post-doctoral staff promotions between grades 6-8 (14 female/6 male). Finally, we have nominated three staff for Royal Society/Wolfson merit awards since 2014 with each one being successful, providing external recognition of the quality of these individuals and the importance of their retention.

Staff **development** is managed through our Performance & Development Review (P&DR) process and mentoring scheme. P&DR is carried out by one member of a gender-balanced team of four. The team meets before and after the review process to discuss individual reviews and to provide consistency. The team approach ensures that one person is not carrying out more than eight reviews and adds checks and balances into the process. For our PDRAs, reviews are carried out by the direct line-manager. All P&DR appraisers are trained to carry out these meetings and how to set SMART objectives. The review entails objective setting, a discussion of the last year's achievements, devising a professional development plan for the next year and a performance evaluation, as well as covering opportunities for promotion.

We **mentor** our staff on a one-to-one basis with meetings between mentors and mentees taking place every three months. All current and new staff 'opt-in' to the scheme by completing our online mentor form. Staff are given the option of requesting a specific mentor. On completion, a mentor is assigned based on the stated applicants' needs. Staff survey data confirm that the mentoring scheme is a great success, with **98%** of respondents **agreeing** that it was beneficial to their personal development.

Communication is key to **staff satisfaction** and in creating an inclusive culture for our staff. It is particularly important for our Institute as staff are split between different buildings. We have fortnightly informal academic forums and quarterly staff meetings, biannual away days for academic staff and annual away days for ECRs, as well as an annual graduate symposium for our PhD students. In addition, we run an external seminar series and an internal seminar series followed by a social event specifically for ECRs. We are very active in social media with a specific committee which evaluates our web presence and co-ordinates our Facebook and Twitter account. Quarterly informal 'coffee morning' meetings take place to promote a friendly and welcoming culture and ensure opportunities for discussion and networking between all UoA5 staff. The importance of communication has never been as important as most recently during the COVID19 restrictions. We have maintained our regular meeting via Zoom and now have additional "all staff" monthly update meetings.

Inclusion strategy: Inclusion is about more than achieving a gender balance, it is also about providing an environment where all feel welcome and can flourish without discrimination. Alongside core hours, gender representative committees and flexible working, we have developed an equality, diversity, and inclusion plan alongside our Athena SWAN action plan and our EPSRC CDT, which now spans our community and dovetails with UofG's strategy for supporting disability, gender, LGBT+ and BAME groups.

We have dedicated webpages, newsletter and conduct an inclusion and work/life balance survey every two years. The survey data are shared and discussed at annual all staff events, allowing us to reflect on progress and focus on improvements. Actions are coordinated through our Athena SWAN self-assessment team.

As a result of our ongoing efforts, UoA5 is now 31% female for academic staff (29% at professorial level compared to 11% in 2014) and gender balanced for PGR students. Of the appointments since 2014 we have a 50/50 gender balance. Notably we have **appointed** two females and one male to professorial posts and **promoted** three female professors.

All those involved in REF processes (including output review and selection) within the UoA undertook mandatory training including ED&I principles, unconscious bias, and sensitive data handling. In accordance with the University's Code of Practice, outputs were selected and allocated to authors to maximise the UoA's GPA. An interim equality impact assessment of our methodology indicated no significant bias against any protected characteristic.

ECR support strategy.

In this section we consider PGR students and PDRAs collectively as ECRs. However, we note that there are specific activities that apply to PGR students.

PGR specific initiatives: Our responsibility to PGR students lies with our cohorts studying for either an MSc or PhD. All our PGR supervisors receive compulsory training in supervision every

five years. We take **inclusion** into account during student recruitment. For example, through our EPSRC CDT, we have developed our website to promote an inclusive environment with positive images of female and BAME students – showing students from all backgrounds that they belong in the PhD programme. This has been successful; we have recruited >60% female students and >10% BAME students to the 2019 cohort and >60% female and >25% BAME to the 2020 cohort; the UK BAME population is ~12% (~4% in Scotland; 2011 Scottish census data).

Recruitment of students from diverse backgrounds into PG research will be further promoted through the inclusion of ED&I training within the undergraduate Life Sciences degrees at UofG (from 2020 onwards). This compulsory course was developed with funding from Wellcome Trust Institutional Strategic Support Fund (ISSF) and challenges perceptions of a career in research.

We **provide training** courses in transferable skills to ensure students are prepared for a career within or outside academia. Each student is assigned either one (MSc) or two (PhD) advisors who offer additional support independent of their direct supervisors (all PhD students must have at least two supervisors). Meetings are held with advisors biannually to discuss student progress and to provide career advice and mentorship. Each student has a personal development plan wherein any additional training or requirements are identified. Our students are funded by and supported with resource to attend specific training events organised by BBSRC, MRC, EPSRC, Wellcome Trust and the Biochemical Society as well as registration and attendance at research conferences.

Each research group holds **frequent meetings** to provide PGR students with opportunities to develop their presentation skills. The internal seminar series allows PhD students to present to a varied audience. These events culminate in an **annual graduate symposium** providing the students with the chance to present their work as talks or posters. At this event, a guest speaker (academia/industry/3rd sector) delivers a presentation on their career path and field of research. These informal and formal gatherings provide opportunities to discover how different people have approached their careers.

Evidence of our success with PGR students is highlighted by our **100% completion** record for the period.

The **COVID19** pandemic and subsequent **lockdown** has created specific problems for our PhD students. To mitigate some of the effects, we encouraged all PhD students to spend lockdown writing a substantive chapter for their thesis that does not require “wet” lab research. This could take the form of a grant application, a review related to their research or bioinformatics analysis. Where the lockdown or personal circumstances caused a significant delay in studies, we enabled affected students to apply for a fully funded extension to their studies. Since the scheme was implemented fifteen students have secured funded extensions ranging from 3-6 months with an additional student receiving an extension for working at the Glasgow Lighthouse COVID19 testing centre.

Initiatives for all ECRs: Our ECR committee comprises 10 members from all research themes and career stages. The committee has access to funds to target specific priorities including workshops focussed on grant writing, fellowship applications, academic and non-academic career paths, and promotion. It organises PDRA Away Days, including speakers from outside academia and key topics such as career development and impact. To ensure inclusion and networking of researchers from across the various campus locations, we organise biweekly seminars with food and drink provided to create a friendly, sociable environment. These sessions have been highly successful in forging a sense of community, greatly improving engagement and collaboration between ECRs.

The chair of the ECR committee is a member of the Institute Management group as well as attending College Management Group meetings providing direct representation of the ECR community at management meetings. The development of our **ECR strategy** can be best illustrated by ongoing events that have been initiated since the 2014 submission:

Biweekly ECR Seminar Series, two speakers per session (with gender balance a priority). Organised and attended by ECRs, followed by social networking. All ECR seminars are publicised via email and social media.

Careers in Industry Event. Female role models from industry give talks about careers in Pharma. The event is attended by all ECRs.

ECR Grant Writing Workshop. Attended by approximately 40 ECRs per event and facilitated by senior staff. The workshops focus on academic career progression and funding opportunities available to ECRs. Both early career and senior academics offer advice on writing fellowship grant applications. For example, an overview of BBSRC fellowship opportunities and panel considerations was provided by a BBSRC panel member. Other activities include the opportunity to participate in a mock interdisciplinary grant writing competition, with groups presenting their ideas to an academic panel made up of academics from UoA5. A high proportion of attendees (75%) have indicated they were more likely to write a grant/fellowship application. Over **95%** found the contents of the workshop to be relevant and useful for future applications.

Networking Opportunities. The UoA hosts 'Meet the Speaker Lunches' following seminars by invited external seminar speakers. This gives our ECRs the opportunity to network and obtain valuable career advice from more senior scientists. At these events our social media team interview the speaker to hear about their career pathways. The interviews are recorded and presented as a Podcast. We have paid attention to attracting female role models to our seminars. Some examples of female role models who have joined our meet the speaker events include Alison Lloyd (Professor from an AS Gold department), Wendy Bickmore (Director of MRC Human Genetics Unit), Judy Hirst (Dean of Corpus Christi College), Lynne Regan (Professor of Interdisciplinary Science) and Marisa Martin-Fernandez (Octopus Central Laser Facility Science leader).

Young Life Scientist Symposium 2018. ECRs from UoA5 collaborated with peers from the University of Strathclyde to obtain funding and organise a Young Life Scientist Symposium. The symposium attracted over 100 ECR attendees. Subjects included an introduction to public engagement, shareable science, and grant writing.

These **initiatives** have developed our **ECR skills** as evidenced by:

- Our ECRs have applied for and obtained more travel awards (e.g. Lister/Bellahouston/Biochemical Society Travelling Fellowships) in the REF period than previously to cover the costs of study visits/collaborations with laboratories or institutions abroad.
- Our ECRs have increased their applications to support the establishment of an independent research portfolio, making use of UofG initiatives such as ECR Catalyst Funding available through ISSF (7 successful awards ranging in value up to £30k); and, externally via e.g. TENOVUS grants (£15k research grants – two successful applications). Further, our clinical students have also been competitive in applying for the Royal College of Surgeons grants (>£74k raised from three clinical fellows) and a CSO/MDUK fellowship (£230k).
- Over the period we had 22 applications for promotion by ECRs to grade 7 or 8 of which 20 were successful.

3. Income, infrastructure and facilities

Income and awards.

Between 2014 - 2019, our research **income** has **increased dramatically** from £5.3M to £9.4M with a concomitant increase in income per FTE from £156k to £275k/annum. A slight drop in 2020 was due to a lack of expenditure during COVID19 lockdown. Of academic staff, 95% hold research grants (July 2020), with over half having awards with a value of over £0.5M and a third over £1M, demonstrating a consistent performance rather than a reliance on the success of a few. This robust income stream is sustained through high success rates for our grant

applications (success rate at BBSRC and MRC in 2019/2020 was 26.8% and 29.4% respectively for award value, above the Russell Group median of 24.4% and 6th in the Russell Group for the total value of Research & Innovation grants awarded).

Examples of major awards to our areas of research strength include.

Molecular and translational pharmacology:

- Collaborative network to define the molecular determinants of GPCR clinical efficacy (**Tobin**), Wellcome Trust Collaborative Award– £4.2M
- MICA Pharmacological, molecular and cellular mechanisms of muscarinic slowing (modification) of neurodegenerative disease (**Tobin, Bradley**), MRC - £2.1M
- The organisational structure of class A GPCRs: Implications for pharmacology, function and therapeutic regulation (**Milligan**), MRC - £1.8M

Structural and mechanistic aspects of protein function:

- Establishing the Scottish Centre for Macromolecular Imaging (SCMI) (**Bhella, Spagnolo and Walden**), MRC - £4.4M
- Regulation of DNA interstrand crosslink repair by ubiquitin (**Walden**), ERC Consolidator award - £1.6M
- Mechanisms of ubiquitin signalling in Parkinson's Disease (**Walden**), Wellcome Trust Investigator award - £1.4M

Redox biology:

- Protein Folding and Thiol Modification in the Mammalian Endoplasmic Reticulum (**Bulleid**), Wellcome Trust Investigator award - £1.5M.
- Thiol Modification and Redox Signalling, MRC discovery award (**Bulleid, Tokatlidis, Hartley**) (UoA8), Touyz (UoA1), Selman (UoA6), Barrett (UoA1), Burchmore (UoA1) – £0.6M.
- ROS via RET: a redox regulated pathway to extend lifespan (**Sanz**), Wellcome Trust Senior Research Fellowship (SRF) - £1.4M.

Centre for Cellular Microenvironment:

- Engineering growth factor microenvironments – a new therapeutic paradigm for regenerative medicine (**Dalby, Salmeron-Sanchez**), EPSRC - £4.5M.
- GMP manufacture and pre-clinical testing of bioengineered bone graft. (**Dalby, Salmeron-Sanchez**), EU - £5M.
- Combined technologies for robust engineering of bone grafts with controlled geometry (**Dalby, Salmeron-Sanchez**), SBCF charity - £2.8M.

Sustaining Agriculture and food:

- Developing novel pesticides (nEUROSTRESSPEP) (**Dow, Davies**), European Commission - £3.5M.
- Functional analysis of insect neuropeptide GPCRs (**Dow, Davies**), BBSRC - £3.4M.
- Combining chemical priming and quantitative genetics to increase salt tolerance of soybean (**Amtmann**), BBSRC - £1.0M.

Other

- Somatic instability in Huntington disease: a driver of pathology, modifier of disease severity and therapeutic target (**Monckton**), CHDI Foundation - £1.5M.

In addition, we have secured substantial funding in partnership with industry (£4.8M). We hold a BBSRC Industrial Partnership Award with AstraZeneca, an MRC IPA with Eli Lilly and an Innovate UK KTP with Cell Guidance Systems. Our EPSRC-CDT has attracted >£700k of stakeholder funding (>£2M of in-kind funding). Staff also have held CASE studentships with Collagen Solutions, Syngenta, BiogelX, Eli Lilly, Ingenza, Xanthella, Glycomar, UCB, Zoetisto,

Procter and Gamble, Marine Biotech, Manchester Biogel and Astra Zeneca. Since 2014 we have also obtained fellowships from both internal (four LKAS) and external sources (Wellcome Trust SRF (**Sanz**), UKRI future leaders fellowship (**Dobson**) and Royal Society University Fellowship (**Karnik**)).

Strategy for generating research income.

Our income generation strategy is underpinned by the same principles as our research and staffing strategies: to **invest in areas of strength** whilst **supporting staff** to achieve their research ambitions.

Investing in areas of strength: major investments in staffing (section 2) and infrastructure (section 1 and below) have driven growth in key areas of research excellence. Over the reporting period our PIs collaborated to generate a portfolio of research awards worth over £83M. Our funding is predominantly UKRI with over 50% from BBSRC (£22.5M); MRC (£13M); EPSRC (£9M) and Innovate UK (£1.3M) with other significant awards from Wellcome Trust (£9M), ERC (£1.6M), and industry partners (£4.8M). Around 30% of these awards involve collaboration with other disciplines, particularly **Chemistry** and **Engineering** and have been catalysed by our targeted **investment** in the multidisciplinary research themes outlined in section 1.

- An **investment** of £500k in laboratory infrastructure and new professorial, lectureship and fellowship positions (2) to attract a Professor of **Molecular Pharmacology (Tobin)** leading to a £4.2M Wellcome Trust collaborative award as well as MRC grants of £2.1, £1.9, and £1.6M and BBSRC grants totalling £3.3M.
- Match funding and **infrastructure development** (£760K) to secure a £4.4M MRC grant to establish the national imaging facility, SCMI. The funding was used to purchase 200 and 300KeV cryoEM instruments. This investment enabled the recruitment of a Professor (**da Fonseca**) and Reader (**Spagnolo**) in structural analysis by cryoEM.
- **Infrastructure** investment in protein characterisation facilities (£150k) as well as upgrades to our NMR (£100k) and X-ray crystallography detection and crystal imaging facilities (£210k). In addition, we recruited a Professor in X-ray crystallography (**Walden**). This led to a £1.4M Wellcome Trust Investigator award and a £1.6M ERC Consolidator award.
- **Facilitating** collaborative grants through organised sandpits and workshops which have led to awards with chemists, engineers, physicists, and mathematicians generating £23.5M since 2014.

Excellent facilities and infrastructure:

Our current estate includes the **Bower, Joseph Black, and Davidson** Buildings. The Bower building was devastated by a fire in 2001 and was completely refurbished to a high standard at a cost of £10.8M finally reopening in 2004. The Davidson Building has seen significant phases of refurbishment, the most recent of which created state of the art laboratories for the recruitment of Tobin (£0.5M, 2017) and upgrades to the air handling system (£0.45M, 2019). In addition, we have an ongoing programme of laboratory and office refurbishment, managed by our University Estates and Buildings team. All PI offices are now located within or next to laboratories enabling our staff to retain close links with their research groups. Communal equipment such as centrifuges and microscopes are clustered near laboratories allowing easy and open access to all researchers. Members of our technical support team provide local management of the laboratory spaces ensuring all aspects of safety are covered.

The University provides funds for equipment and infrastructure improvements linked either to recruitment or to supporting our researchers. We have been very successful in securing these funds. In addition to the major refurbishments detailed above, we have invested over £10M in minor laboratory upgrades, new plant growth facilities including new LED lighting and growth chambers (£425k), upgrades to our 600 MHz NMR (£100k), equipment for our structural biology/biophysical characterisation facility (£150k), and new light microscope systems (£150k).

To best manage our core technologies, we group our resources into facilities and provide dedicated technical support to ensure they are both maintained and developed. The main core facilities are:

- Glasgow Polyomics Facility. Established with £2.2M from Wellcome Trust ISSF, the facility embeds omics technologies within UofG and provides cutting-edge support for next generation sequencing, metabolomics, proteomics, and transcriptomics. An ECR Catalyst funding scheme is available to support the development of omics projects.
- Structural biology/biophysical characterisation. This facility provides support for all aspects of structural biology as well as analytical ultracentrifugation, dynamic light scattering, ITC, CD, FT-IR, fluorescent and UV spectroscopy, and microscale thermophoresis.
- Light microscopy facility. The facility provides access to various confocal and epi-fluorescent microscopes including a Leica FRET-FLIM system. We also have a range of fluorescent plate readers which are managed through this facility. In addition, we have access to other imaging facilities available within UoG such as super-resolution microscopy and electron microscopy run through the Glasgow Imaging Facility.
- SCMI houses the latest Jeol 200 keV and 300 keV instruments for high resolution single particle analysis.

Supporting staff to succeed:

A dedicated **research support team** (2FTE) is embedded within the Institute to provide hands-on support for grant applications, including overseeing **peer review** processes for applications and organising **mock interviews** (e.g. fellowships) and to provide project management for awards. All grants are read by senior members of staff, often from outside the immediate research area, to provide feedback on grantsmanship and readability. This advice is also provided when applicants are responding to reviewers' comments. This process of review is also provided for respective external and internal fellowship applicants to maximise their chances of success. In cases where applications are unsuccessful, we provide **de-briefing sessions** with senior colleagues to support staff to maintain motivation and to maximise the value of the feedback provided to improve the chance of success next time. We provide additional support for our ECR community through **regular Grant Writing Workshops**, facilitated by senior staff (section 2).

Business development support and seed funding is available via the Translational Research Initiative (led by **Tobin**, section 1). Our success in securing translational funding of over £4.5M from MRC (Confidence in Concept (CiC), Proximity to Discovery (P2D)), BBSRC (IAA), and Wellcome Trust (Translational Partnership) has fuelled our impact agenda and will form the basis of impact generation for years to come. Our Unit has benefitted particularly from this initiative with funding to provide workshops with industry, market assessments and relevant mentoring leading the generation of a range of licensing and spin out opportunities.

Successes where our research will lead to defined impact are detailed in section 1 but are highlighted by the spin-out of Caldan Therapeutics, and most recently Keltic Pharma and Solasta Bioscience. The latter spin-out is led by **Davies** and **Dow** who are developing green pesticides. The team have secured three BBSRC CASE awards, a BBSRC IPA and contract research (value £1.5M). Further, **Davies** secured a BBSRC FLIP award (£50k) to work closely with BASF 2014-2016, BBSRC IAA funding for market research (£5k) and technical development (£30k), and BBSRC 'Excellence with Impact' funding for patent freedom-to-operate searches (£6k). This experience has helped them develop insecticide targets. Through a large EU project (€7M) they focussed on technology development and stakeholder interactions for peptide-based insecticides. They secured Scottish Enterprise High Growth Spinout Funding (£150k) and **Davies** has been awarded a BBSRC/Royal Society of Edinburgh Enterprise Fellowship (2019-2021, £54k) and Scottish Enterprise High-Growth Spinout funding (£168k). They have identified a CEO and have spun out Solasta Bioscience. **Davies** recently won Glasgow's New Entrepreneur of the Year (2020).

We have very recently (2020) added to our pipeline of spin-out companies by establishing Keltic Pharma Therapeutics, founded by **Tobin, Milligan**, and **Jamieson** (UoA8) with substantial start-up funding from the EU (€26M). This company will pursue drug discovery in the areas of malaria, asthma and neuropsychiatric disease as well as establish a novel drug discovery platform called PEP-SMOL. The company builds on the expertise of the **Tobin** group in malaria, the **Tobin-Milligan** groups in GPCR pharmacology and the **Jamieson** group in cyclic-peptide chemistry. The company presents translational opportunities for exciting clinical targets being pursued by the founders and is likely to build on its current portfolio of therapeutic areas.

Future infrastructure improvement

By far the biggest impact for our infrastructure in the next few years will be the opening of the ARC (Advanced Research Centre), a £113M “Research Hub” focussed on interdisciplinary research (scheduled for 2022). With leadership from **Tobin**, this development will build upon our already extensive interdisciplinary approaches and provide high quality interactive research space for existing groups as well as new researchers. In addition to providing new space for recruitment and to house excellent communal facilities, the building has interaction spaces that will create a research culture to foster interdisciplinary research and encourage large, multi-applicant grant applications. These spaces will also be available for public lectures and exhibits, improving our facilities for public engagement. Several of the UoA5 staff will relocate to the ARC which will also free-up high quality research laboratories in existing buildings. This will allow for future expansion and provide the opportunity for a consolidation of our core facilities such as our protein characterisation facility and imaging.

4. Collaboration and contribution to the research base, economy and society

The Unit is making a leading contribution to the research base both nationally and internationally as evidenced by engagement with grant awarding bodies, our contributions to learned societies and our extensive collaborations.

External collaborations:

Our **UK collaborations** include an EPSRC programme grant with University of Nottingham and Imperial College, a SBCF programme grant with the Universities of Nottingham and Strathclyde. **Internationally**, we are partner and coordinators on H2020 awards with 24 partner universities and we also hold a Wellcome Trust Collaborative Award with Monash University, Australia. Since 2014, 60% of our publications have included an international partner.

Our **industrial collaborations** have generated £4.8M of collaborative income since 2014 and range from global multinationals (Proctor & Gamble, New England Biolabs, BASF, Airbus Group, Agilent, Johnson and Johnson) and big pharma (Sosei-Heptares, Eli Lilly, Novo Nordisk, Tianjin Modern Traditional Chinese Medicine, Vertex Pharmaceuticals) to SMEs (AMO-Pharma, Grünenthal, Cara Therapeutics, Flagship Pioneering, In Sphero, Histocell Atelerix, BNN Technologies, BiogelX, ReNeuron, Reprocell, Terumo Aortic, QuantumDX, Sphere Fluidics, Metrion Biosciences, Spheritech, Ingenza, Xanthella, Collagen Solutions and Cell Guidance Systems). Since, 2014 7% of our publications have included industry.

To enhance our collaborations with industry, we have established a strategic relationship with IBioC (Industrial Biotechnology Innovation Centre) in Glasgow. IBioC comprises 150 member companies (**Amtmann** sits on the IBioC advisory board). Formed in 2014, its mission is to grow a £900M biotech industry in Scotland by 2025. An illustration of how we embed an industrial outlook in training our future scientists, is our EPSRC CDT. On this programme each student has an industrial supervisor and will undertake industrial placements during their PhD.

Our developing impact pipeline involves considerable industrial collaboration, and we are supporting these opportunities through to company formation where appropriate. Examples include:

- **Milligan** (UoA5 impact case study) has worked with Pharma for many years forming a strategic partnership with AstraZeneca, even licensing IP to Cara Therapeutics (realised

by UoG in 2018 for US\$4M). His interest in GPCR signalling in diabetes and his understanding of Pharma from his many interactions led him to spin-out Caldan Therapeutics in 2015, taking in £4.5M of venture capital from Epidarex to identify drug targets for type II diabetes. Subsequently Caldan has raised further £3.5M in venture capital, largely from LifeArc Seeds.

- **Davies** and **Dow** have worked closely with BASF through BBSRC FLIP and IPA funding to develop novel insecticides. **Davies** is now developing her entrepreneurial skills through a Royal Society of Edinburgh Enterprise Fellowship. Together they have secured Scottish Enterprise High-Growth Spin Out funding (£168k) for Solasta Bioscience that requires projection of £5M turnover within 5 years of start-up.
- **Monckton**, through his work with CHDI, Muscular Dystrophy UK, the NHS and Vertex Pharmaceuticals, has become the go-to person in the field of sequencing and genotyping myotonic dystrophy and Huntington disease patients. With his collaborators, he is developing new, accurate diagnostics and novel therapies.
- **Dalby**, with **Salmeron-Sanchez** and SBCF as well as the NHS and HistoCell have delivered a first veterinary trial of a bone scaffolding technology, which has now benefited 10 dogs and a cat in Glasgow and Liverpool. In addition, the team are delivering a cellular therapy to humans for bone regeneration. They are currently working with, plastic surgeon Prof Andy Hart, a regulatory consultant and the Medicines and Healthcare Products Regulatory Agency (MHRA) to obtain clinical trials approval. At time of trial, they will seek funding to spin out the cellular therapy.
- **Riehle** with work emerging from NC3Rs Crackit funding with Grünenthal and Metrion to establish cultures of human dorsal root ganglions to enable better drug screening. Further, **Riehle** is undertaking a Cochrane review of best surgical practice in nerve conduit technology that could inform surgical practice in the NHS.

Contribution to the research base, economy and society

The most important contribution that UoA5 staff provide to the research base is through commitments to grant funding panels and reviews. **Cogdell** is Chair of the Royal Society research grant panel and sits on the Royal Society Newton Bhabha Fellowship Board. He was also on the BBSRC Council and is a member of the scientific advisory board of the Centre of International Excellence "Alexander von Humboldt" at University of Bayreuth. **Bulleid** sits on Wellcome Trust Expert Review panel for Cell and Developmental Biology as well as the Royal Society of Edinburgh Nominations panel A4. **Walden** chairs both the Wellcome Trust Expert Review panel for Molecular Basis of Cell Function and the Biochemical Society grants committee. **Dow** is the deputy Chair of the REF subpanel A5 and a member of the BBSRC-DTP3 interview panel. **Milligan** is also a member of the REF subpanel A5 and sits on the MRC Molecular and Cellular Medicine group. **Blatt** is a core member of the BBSRC committee B and is the Chair of the Trustees for the Begonia Trust. **Monckton** is on the scientific advisory board and grant review panel for the Myotonic Dystrophy Foundation (USA). **Stark** is in the UKRI FLF panel and sits on the Carnegie Trust panel for Research Incentive grants. **Davies** is a member of BBSRC committee E and is Chair of the FWO Belgium Bio2 grants and Fellowships committee as well as sitting on the research council of Norway grants panel. **Tokatlidis** is a member of the UKRI FLF panel and sits on the German Research Organisation (DFG)- research networks panel. **Insall** was a member of the following panels: MRC, Molecular and Cellular Medicine Board, Discovery Awards and "Technology Touching Life". He is also on the UKRI FLF panel, UKRI Physics of Life external advisory and the Biochemical Society awards committees. **Tobin** was on the MRC Molecular Cellular Medicine Board and carries out site reviews for MRC centres and is a member of the Scottish Parliament Cross-Party Committee for Life Sciences. **Dalby** sits on the Royal Society of Edinburgh Nominations panel A1.

Participation in peer-review

All of us are engaged in peer-review for journals and act as external examiners, at undergraduate, masters and PhD cohort level. We have Editorial roles for journals in our fields. **Amtmann** is Editor-in-Chief of Plant Cell & Environment, **Blatt** is Editor-in-Chief of Plant Physiology and **Cogdell** is Editor-in-Chief of Journal of the Royal Society Interface. We serve

as associate or monitoring editors: **Blatt** for Frontiers in Plant Sciences, **Dow** for Journal of Experimental Biology, Fly and Briefings in Functional Genomics, **Jenkins** for Photochemical and Photobiological Sciences, **Kaiserli** for Plant Physiology, **Dalby** for Materials Science and Engineering C and Journal of Tissue Engineering, **Riehle** for Micro- and Nano Letters, **Christie** for New Phytologist and Plant Physiology, and **Jones** for Journal of Experimental Botany.

Conference organisation

Our unit is involved in chairing and organising international meetings (e.g. Gordon Research Conferences) with several of these attracting internationally renowned researchers to UofG. These recently include: the International Workshop on Plant Membrane Biology (**Blatt, Karnik**); 29th Conference of European Comparative Endocrinologists (**Dow, Davies**); Plant Cell Environment 40th Anniversary Symposium (**Amtmann**); EMBO meeting on Protein modules in Signalling Networks (2018) and Biochemical Society Hot Topics “PINK1-Parkin Signalling” (2014) (**Walden**); principal organiser of the Collaborative Computation Project for NMR (CCPN) annual conference in 2017 (**Smith**); Gordon Research Conference on Photosensory Receptors and Signal Transduction vice chair 2014 and Chair in 2016 (**Christie**); EMBO-FEBS Lecture Course on Mitochondria in Health, Death and Disease Chair (2015) organising committee (2017) and EMBO-LIFE conference (2020) organising committee (**Tokatlidis**).

Fellowships and awards

Of the 36 PIs submitted to UoA5, six currently hold prestigious personal Research Fellowships. During the assessment period we were awarded a Wellcome Trust Senior Research Fellowship, an UKRI Future Leaders Fellowship, a Royal Society University Research Fellowship, a Royal Society of Edinburgh Enterprise Fellowship and three Royal Society/Wolfson Merit awards. We have used our internal Fellowship programme strategically to attract six Lord Kelvin Adam Smith Fellows four of whom now have permanent positions. Over the assessment period we have also been recognised by: Biochemical Society Industrial-Academic Collaboration Award (**Dalby**), Colworth Medal (**Walden**), Goodwin Prize (**Cogdell**), Herald Research Project of the Year (**Dalby**), JR Vane Medal for Pharmacology (**Milligan**), Muscular Dystrophy UK Scientist of the Year and Huntington's Disease Society of America Researcher of the Year (**Monckton**), and Glasgow's New Entrepreneur of the Year (2020) (**Davies**). Over the assessment period PIs have been elected: Academy of Medical Sciences FMedSci (**Milligan**), Royal Society of Edinburgh FRSE (**Christie, Dalby, Davies, Insall and Tokatlidis**) (34% of submitted staff are now FRSE), Fellow of the Royal Society of Chemistry (**Spagnolo**) and EMBO member (**Tokatlidis**).

Influencing policy

Members of UoA5 are involved in helping make policy for various research organisations: **Smith** is secretary of the executive committee of the CCPNMR (UKRI Collaborative Computation Project for NMR) and is a member of the executive committee of the Scottish High Field NMR Centre; **Blatt** advises the Scottish Parliament Information Centre (SPICe) regarding science communication; **Cogdell** chairs the scientific advisory board of the Canadian Institute for Advanced Research's program on Bioinspired Solar Energy. He is also a member of Queens University Belfast's international scientific advisory board of their Institute for Global Food Security and is a member of the US department of Energy's Energy Frontier Research Centre on Photosynthetic Antennas. Further, he sat on the scientific advisory board of the Roslin Institute from 2016-2018.

We have grown strong links with the NHS. **Dalby** formed the Glasgow orthopaedic research initiative (GLORI) in 2009 with surgeon Prof Meek. Since 2014, the initiative has grown and annual meetings now attract sponsorship, bring in top speakers to inspire young orthopaedic researchers and have encouraged more trainee surgeons into PhD study. Ten years ago, UofG was unknown for orthopaedic research, now we are producing research-trained fellows each year and hosting annual meetings with broader appeal and attendance. Further, plastic surgeon Prof Hart has worked with **Riehle** to develop research positions in the NHS where trainees can work 50% in clinic and 50% on PhDs (first submissions due 2021). **Monckton** is a long-standing member of the Scottish Muscle Network and Myotonic Dystrophy Managed Clinical Network,

leading a national research project and providing *ad hoc* diagnostic capabilities in complex cases. **Monckton** also co-supervised a joint Chief Scientist's Office/MDUK clinical PhD fellow who has subsequently attained a consultant position in Clinical Genetics at the Queen Elizabeth University Hospital.

Public engagement

We have an extensive public outreach programme which involves both staging events or exhibitions and interaction with the media. The events/exhibits we have organised include participation in the Royal Society Summer Exhibition in 2016 and 2018, exhibits at the Glasgow Science Centre, exhibits at Science Sundays (UofG), Plant Sciences Explorathon and Botanical Garden's Centenary Celebrations. **Nimmo** and **Dalby** have been involved in two Leverhulme Trust artist in residence projects on circadian clocks and the osteogenic properties of mother of pearl. The work of both artists was displayed within university museums with free entry to the public. We are also working towards a public outreach impact case with **Karnik's** Stomatoy (described in section 1). **Monckton** organised and hosted a Muscular Dystrophy UK Scottish Patient Research Day and regularly hosts patients and families in laboratory visits.

Our interactions with the media help us disseminate new, potentially impactful, science to the public. Some examples are below:

- **Dalby** for his work with **Salmeron-Sanchez** and SBCF on saving the leg of Eva the dog. The basis of this work was published in Science Advances 2016 and the veterinary case was published in Advanced Science in 2018. The work was featured both immediately after successful surgical follow up in the news, and then became the focus of an extended BBC news piece by Pallab Ghosh. The extended story featured in the main BBC news, every hour on the BBC news channel featuring interviews with **Dalby**, **Salmeron-Sanchez**, Eva's owners and the veterinary surgeon. It was also covered by many papers and websites.
- **Dalby** for his work on nanovibrational stimulation of stem cells published in Nature Biomedical Engineering in 2017. As well as attracting press attention, including BBC Scotland, STV and many newspapers and websites, the work was a feature in the Channel 4 health series 'Live Well for Longer'.
- **Cogdell** appeared on BBC Radio Scotland and German radio concerning Artificial photosynthesis. He also gave talks on climate change and the role of artificial photosynthesis to Glasgow Probus, Helensburgh and Milngavie branches of the University of the 3rd age.
- **Blatt** and **Christie** have developed an approach to help plants grow with less water usage. This was published in Science in 2019 and attracted broad newspaper and news website attention with **Blatt** being interviewed for e.g. the BBC Today programme and the Naked Scientist.
- **Milligan** and **Tobin** who, in a paper in Nature Chemical Biology 2019, showed that we can mimic positive effects of gut bacteria on sugar levels using drug targets. They were interviewed for radio and newspapers.
- **Berry** was interviewed by the Scottish Herald following her 2016 ACS Nano paper on stem cell niches in a dish and **Riehle's** work with engineers at UofG and Herriot-Watt was featured in many newspapers after publication in Lab on a Chip 2014, with parallels to Dr Who's sonic screwdriver.

In addition to these mainstream media outreach activities, we have also been involved in production of a UofG MOOC "Research Impact: Making a difference". This online course is designed to overview and educate on academic impact with examples from UoA5 staff such as **Milligan** and **Dalby**. The course is proving popular and more importantly useful. The course has run 5 times since 2018 with over 3,500 learners taking part. Learners come from across the globe with around 30% from low to middle income countries.

In summary, we work around the world and with academics, clinicians, and industry. We are balancing world-leading basic science with exciting innovation and translation – and we are telling our peers and the public about this through outreach and the media.