

Institution: University of Kent
Unit of Assessment: 5, Biological Sciences
<p>a. Context</p> <p>The School of Biosciences at Kent has a 40 year strong track record of close collaboration with bio-focused industries, and continues actively to promote interactions with end users of its research, in particular the biopharmaceutical, environmental bioremediation, diagnostic and animal health sectors. Through the provision of new tools and enhanced technologies, our research has impacted in particular on the production of high value protein-based therapeutics and on in vitro fertilisation in humans and farm animals. Ensuring impact lies at the core of the School's research strategy and our success since 2008 is demonstrated through industrial consultancies with six different companies; 22 CASE PhD studentships with 10 different industrial partners; £400k income from licensing IP; and £2.2 million of funding directly from industry. Furthermore, we ensure the impact of our research is felt by the wider community through public engagement, science communication and influence on public health policy and practice.</p>
<p>b. Approach to impact</p> <p>With a strong research portfolio spanning the molecular and cellular biosciences, coupled with access to in-house, cutting edge research facilities for macromolecular analysis, cell imaging and protein structure determination, staff are well positioned to provide innovative and creative solutions that impact on the biotechnology, human and animal health and biopharmaceutical sectors.</p> <p>Working with end-users</p> <p>Staff have a proven track record of working effectively with end-users of their research. Our long history of delivering high quality research and training has resulted in skills transfers, with postgraduate students and research staff trained in diverse areas of bioprocessing who can now be found throughout UK industry. For example, since 2008 twelve PhD students have directly entered the biopharmaceutical sector.</p> <p>Significant levels of funding have been obtained via jointly funded Research Council-industry initiatives. These include a grant of £988k (started in 2007) to support a project entitled <i>Characterisation of post-transcriptional constraints that determine recombinant protein yield during bioprocessing in mammalian cells</i> (Smales, von der Haar, Tuite) through the BBSRC's BRIC (Bioprocessing Research Industry Club) and a TSB/BBSRC/Industry initiative (involving JSR Genetics and the Bridge IVF centre) of £470k to Griffin to support his research in human and animal IVF (see Impact Case ICS2_CHR). Other research funders have included major biopharmaceutical companies such as Lonza Biologics, MedImmune, Pfizer Ltd and UCB Celltech, for projects including the development of eukaryotic cell-based expression systems (see Impact Cases ICS1_PDI and ICS3_BPH), downstream processing strategies and the study of receptor tyrosine kinases. Sanofi-Pasteur, Novozymes and Cairn Research Ltd have also directly supported research projects and two Knowledge Transfer Partnerships (KTP) have been funded in the School (Smales - Cell Projects Ltd and Griffin - Cytocell Ltd).</p> <p>The School benefits from having three members of staff who have previously worked in industry (Brown, D – Pfizer; Nicholls – Celltech; Robinson, G – Carbury Herne) while the School has made a number of strategic Honorary and Visiting appointments since 2008 including Paul Davis (CEO Mologic); Peter Goodfellow (formerly GlaxoSmithKline), Graham Darby (GlaxoSmithKline), and Michael Ellis (CEO Digital Scientific UK). These individuals provide School staff and students with advice on how to engage and interact with key end-users and have an input into strategic developments in the translation of our research to the market place. The School is also host to the Structural Biology and Biophysics group of Argenta, a leader in drug discovery services. The group, formed in 2011 by ex-Pfizer scientists and led by Brown, D are experts in the application of protein crystallography and biophysical techniques to drug discovery and work closely with the School's Protein Science groups.</p> <p>Institutional support for impact</p> <p>A member of Biosciences' staff is 50% seconded as the Senior Commercialisation Manager in the University of Kent's Innovation & Enterprise (KIE) department and raises awareness amongst staff of the funding opportunities that exist for further development and exploitation of their research. He also provides advice on how to protect any emerging intellectual property. In</p>

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addition, KIE provides professional support to develop **business collaborations** for the purpose of exploiting research outputs for commercialisation, consultancy and training. KIE has a dedicated business development team that works to increase public, private and third sector collaborations and provides support for **leveraging external funding** and co-funding, costing, negotiating and managing projects. University-funded schemes to support this activity include an '**Innovation Fund**', '**Ideas' Factory**' pump priming and '**Patent and Commercialisation Fund**'. In the last three years members of the School have successfully bid for KIE support through these various activities, in particular the Ideas Factory where 11 awards (£99k) have been made to staff and students in Biosciences.

School support for impact

The School runs a weekly **Forum for Innovation, Research and Enterprise in Biosciences** (FIREBio) to promote awareness of the exploitation and impact of its research. Recent sessions have included a 'Dragons' Den' (June 2013) at which research staff and postgraduates presented novel ideas on how to exploit their research, and seminars by scientists from one of the bio-industries (e.g. Lonza Biologics) or support services (e.g. MRC-Technology). Other activities related to impact are included in the School's 'work allocation model'. In 2011, three of the School's PhD students participated in the Virginia Tech USA 'Big Ideas' business plan competition and were awarded second prize.

Outreach activities

The School plan puts a high priority on **outreach activity**, ensuring that the next generation of (bio)scientists are aware of what research is and how it can be exploited. To achieve this the School runs a wide range of activities and talks for **junior and secondary school pupils**, and actively seeks to develop projects and demonstrations to take out to local schools and science festivals (e.g. Kent Festival of Science), or for school students to participate in on campus, e.g. Nuffield Bursary placements. The annual commitment from staff and students to these activities is in excess of 400 hours per year, involving on **average 30 separate activities per year**. For example, in 2008 the School, in conjunction with the Simon Langton School for Boys, instigated the school pupil-based MBP² project (www.mbp-squared.org) on the molecular basis of multiple sclerosis that involves over 100 students from year 12/13 in hands-on experimental work every year. This model of research-in-schools first developed by the School, has now spread nationally via Wellcome Trust 'People Award' funding, and the newly launched 'Authentic Biology' project (www.authentic-biology.org) which involves four other universities (Queen Mary London, Bristol, Sheffield, Southampton) and their city-based secondary schools, impacting on over 1000 pupils.

The School's Outreach Officer (currently Gourlay) furthers our activities in the area of impact within the local community. For example, one third of our academic staff have contributed to **Café Scientifique**, a monthly series of open talks and discussions about science and technology that take place in informal public venues in Canterbury.

Impact examples

Since 2008, the close working relationship and the value we place on our interactions with industry and schools can be illustrated in a number of ways in addition to co-funded or fully funded projects. These include: (a) **22 CASE PhD studentships** with sponsors such as Hitech/Tgk Scientific, Pfizer, Cairn Research, Syngenta, GSK, Lonza Biologics, Digital Scientific UK and JSR Genetics; (b) the award of **Royal Society Industry Fellowships** to two members of staff: Mulvihill (2012-16) to work with Cairn Research Ltd, an independent scientific instruments manufacturer that specialises on high resolution microscopy, and Smales (2013-17) to work with Lonza Biologics plc and to build on the technologies described in Impact Case ICS3_BPH; (c) **consultancies** with BlueGnome, Vernalis, Mologic, Symphogen SAB, Lonza Biologics and Metabolic Explorer; and (d) **patents and collaborative protection** with Merck, Lonza Biologics and Thrombinoscope. The School also places on average seven undergraduates a year in a bio-related industry (e.g. GSK, Pfizer, Eli Lilly, Sekisui Diagnostics and MedImmune), overseas biotechnology institutes (e.g. BIOTEC, Thailand; Bayer, Germany) and UK health and support agencies (e.g. NHS, HPA, MRC Technology). These are part of our successful longstanding '**sandwich degree**' programme which also provides an important conduit for School staff to develop new industrial interactions.

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c. Strategy and plans

The School's 'impact strategy' draws heavily on the University's Research and Impact Strategy (2013-16) by prioritising innovative and world-leading research, and striving to have a positive impact regionally, nationally and internationally.

A key area for future development will be the **Centre for Molecular Processing (CMP)**, established by the University in 2010 to promote industrial interactions (Director, Smales). Research and training in the CMP focuses primarily on the synthesis of biotherapeutic agents and biomedicines from biological systems. CMP-based staff work with funding agencies, academic colleagues and industrial partners to deliver research and training in areas that help meet the current strategic need of the industrial and academic bioprocessing community. The CMP acts as a focal point to attract end-users and to demonstrate how the research in the School can and is being translated to the bioindustry sector. In the last two years three CMP-based appointments (Michaelis, Robinson, C. and Wass) have been made in key strategic areas. **IP associated with CMP's activities has already generated £500K** with an annual target of £200K for income from industrial collaborations. The IP co-owned with Merck (see Impact Case ICS1_PDI) is a good example of what is possible. Members of the CMP have worked closely with senior industrial scientists in order to raise the awareness of CMP's research activities and to ensure there is a close dialogue with the end-users. This relationship will be formalised and extended through the establishment of a 'Scientific Steering Group' which will include senior industrial scientists.

In 2013 the School established the post of **Industrial Liaison Officer** to provide further support and guidance to staff on how best to ensure their research has impact. The appointee has responsibility for administering the £100k awarded to the School in 2013, by the BBSRC through its 'Excellence with Impact' initiative.

d. Relationship to case studies

Our impact case studies cover two core areas of research activity within the School: the development of improved technologies for the production of high value recombinant proteins and the development of new approaches to identifying chromosomal aberrations in humans and other animals. In each case the impact has emerged through both recognition of the potential application by those who did the research coupled with effective and timely support from the University to protect and exploit the findings made prior to publication.

ICS1-PDI: the key patent was based on research conducted in the Tuite & Freedman laboratories at Kent co-funded by Merck & Co and the BBSRC. With input from both the industrial co-inventors and the University, the IP has subsequently been successfully protected and exploited. The experience gained and the lessons learned through this process have subsequently informed the University's strategy for IP protection and exploitation facilitated by the establishment the University's KIE department in 2003. Through the efforts of KIE the patent has been licensed to two companies and discussions with other potential licensees continue.

ICS2-CHR: builds on the long-term translational activities of Griffin and his collaborators within the in vitro fertilisation community (e.g. London Bridge Fertility Clinic) and agricultural improvement companies (e.g. JSR Genetics, a pig breeding company). The Karyomapping technology emerged through long term collaborations led by Griffin and Handyside that drove the development of a set of genetic tools and protocols. Whilst there was a commonality in the approaches taken by the collaborators, each built a bespoke knowledge and technology base that allowed innovative diagnosis based on complex genome-wide biomarkers to be developed and exploited in both human and animal health sectors.

ICS3-BPH: Smales has attracted considerable interest from the pharmaceutical sector for his innovative and timely research into what limits production of recombinant proteins in cultured mammalian cells. He has built a close working relationship with several major companies including Lonza Biologics, Pfizer and Medimmune and, with the help of the University's KIE team, has ensured that appropriate IP protection and exploitation is in place. Smales also contributes to national bodies that oversee the academic-industrial interface and the establishment of the Centre for Molecular Processing, which Smales directs, provides the framework for further developing and expanding his industrially-relevant research programmes.