

<p>Institution: University of Kent and University of Greenwich</p> <p>Unit of Assessment: 3 Allied Health Professions, Dentistry, Nursing and Pharmacy.</p> <p>a. Overview</p> <p>The Medway School of Pharmacy (MSOP) is a collaboration between the University of Greenwich and the University of Kent, hence this is a joint submission from both Universities. The research of the school is governed primarily by the University of Kent. MSOP is located at the heart of a multi-university campus (Universities of Kent and Greenwich and Canterbury Christchurch University) at Chatham Maritime in Kent. The Edwardian redbrick campus, dating from 1903, has benefited from over £50 million capital investment since 1996, including the opening of extensive new laboratories and research facilities.</p> <p>MSOP was established in 2004 with all academic research staff appointed in 2006 or later. The School comprises three research groups: Biological Sciences (BS), Chemistry and Drug Delivery (CDD) and Clinical and Professional Practice (CPP). BS has main research themes in neuroscience; renal & cardiovascular physiology & pharmacology; and infectious diseases & allergy. CDD has main research themes on pharmaceuticals & drug delivery; medicinal chemistry; and materials science. CPP research focuses on the best use of medicines and supporting improvements in public health.</p> <p>b. Research strategy</p> <p><u>2008-2013 Strategy</u></p> <p>Following the appointments of Prof Iain Cumming as Head of the School and Prof Alistair Mathie (submitted academics in bold throughout) as Director of Research and Enterprise in 2007, the School developed its research strategy in 2008. This set out a number of aims to be achieved in the years 2008-2013. Principal among these aims were to 1) establish an international research reputation by producing high quality research. 2) Obtain external funding to support and sustain our research effort. 3) Develop wide ranging collaborative links both within the UK and internationally; with academia, industry and health care providers. 4) Where possible, ensure that our research has relevance for (and impact on) the activities of the pharmaceutical industry and health care providers (see REF3a). The School invested heavily (>£4 million) in newly refurbished research laboratories for biological sciences and chemistry, start-up resources for all newly appointed research-active academic staff and around 30 bursaries for research PhD students to “kick start” the School’s research environment. Since 2008, research active academics have built on their strong publication records achieved prior to joining the School, with strong publications arising from work carried out wholly or in part in the School itself. In the three years 2006-2008, Scopus shows just 28 research outputs from the School. In contrast, between 2008 and October 2013, Scopus shows the School has had over 250 outputs which have received over 3,500 citations to date. Prior to 2008, the School had attracted £175K in external research and enterprise income. Since August 2008, the School has attracted over £3.8 million in new research income including major grant support from the MRC, BBSRC, Royal Society, BHF, KRUK and Wellcome Trust and several awards from major pharmaceutical companies (such as Pfizer and Teva). Notable amongst research outputs and grant income arising from the School are the large number which are built on collaborative ventures with other academics and industry. Examples of such collaborative ventures and the individual achievements in each research group are given below.</p> <p><u>Strategy for 2014 onwards</u></p> <p>The research strategy of the School, going forward, has two broad aims. 1) To build on existing excellent research in BS and CDD. 2) To invest in our research activities in CPP under the leadership of Prof Janet Krska. Our over-riding strategy is to encourage research collaborations with other academics, industry and health-service providers and this informs each individual academic’s research. As such, the School has a Research Plan which is updated annually and is linked to similar plans for each research group. Each research-active faculty member within the School develops their own individual research plan which informs the school plan. School plans are discussed annually with the Faculty of Sciences (Kent) Director of Research. Within the plan, targets for research income to sustain research performance within the School are identified, taking into account comparisons with aspirational peer groups and externally bench-marked against high quality, successful peers. For Pharmacy, our target new grant income is £1.35 million</p>

Environment template (REF5)

in 2013-2014 rising to £1.8 million in 2017-2018. The School's research strategy also draws heavily on the University of Kent's Research and Impact Strategy (2013-16) which prioritises innovative and world-leading research, strives to have a positive impact regionally, nationally and internationally and is aligned with the University of Greenwich's Strategic Plan (2012-2017).

Research Groups

The school's three research groups, Biological Sciences (BS), Chemistry and Drug Delivery (CDD) and Clinical and Professional Practice (CPP) each have a number of key research themes.

Biological Sciences Group

Research in Biological Sciences is arranged in three broad themes, Neuroscience, Renal & Cardiovascular Physiology & Pharmacology and Infectious Diseases & Allergy, with considerable overlap between themes and collaborations with other researchers both within and out-with the School.

The Neuroscience Theme comprises six academic staff, **Dr G Lall**, **Prof A Mathie**, **Dr A Baines**, Dr A Bratt and Dr S Kelley augmented by the appointment of **Prof Y Ushkaryov** from Imperial College London in November 2011. Their research interests centre on the role of receptors and ion channels in neuronal transmitter release and function and how these underlie physiological processes such as circadian rhythms and pathophysiological processes such as pain perception. A common experimental approach both in this group and the renal and cardiovascular theme is the use of electrophysiology and we have a critical mass of research teams with significant expertise in this area. Within the field of retinal physiology and circadian neurobiology, **Lall**, in collaboration with colleagues in Manchester and elsewhere, has contributed significantly in defining the role of retinal cones in non-image forming vision (*Neuron*, Lall's output number 2, Lal02) and in further establishing a new neural pathway by which rods and cones mediate their effects on the entrainment of the mammalian circadian system (*Nature*, Lal01). His recent work, supported by the Royal Society has contributed significantly to identifying the roles played by each photoreceptor class in mediating mammalian non-image forming vision (Lal04). **Ushkaryov** and his group, in a paper published in *PNAS* (Ush03) has discovered that brain proteins teneurin 2 and latrophilin 1 form a trans-synaptic receptor pair that is involved in neuronal pathfinding and in the regulation of presynaptic neurotransmitter secretion. **Mathie**, supported by a Royal Society Industry Fellowship, and an IPA grant from BBSRC with colleagues in Oxford and at Pfizer, has helped to further understanding of the function and role of two pore domain potassium channels which underlie the activity of neurons involved in pain pathways in publications in the *Journal of Biological Chemistry* (Mat01-02) and elsewhere. **Baines**, with support from BBSRC, has discovered a novel cytoskeletal interconnector CAMSAP1 that is required for axon outgrowth and links microtubules to spectrin (Bai02 and Bai04). Kelley has received Royal Society support for his research on ligand gated ion channels. Current collaborations within the group include work by **Lall** and **Mathie** on the role of potassium channels in circadian entrainment, work between **Ushkaryov** and Bratt on the role of latrophilin in ADHD and work between **Mathie** and **Ushkaryov** on the link between latrophilin and neuronal ion channels.

The Renal & Cardiovascular Physiology & Pharmacology Theme, was established in 2012 following the strategic appointments of **Dr C Peppiatt-Wildman** and **Dr S Wildman** and comprises five academic staff, **Drs Wildman** and **Peppiatt-Wildman** together with **Dr A Baines**, Dr S Kelley and **Dr Loo** and a visiting academic Professor Ghazwan Butrous. Supported by an MRC fellowship (to **Peppiatt-Wildman**) and grants from Pfizer, Biogen, KRUK, Wellcome Trust and BBSRC, **Wildman** and **Peppiatt-Wildman** have established imaging and electrophysiological approaches to investigate the properties and regulation of renal tubules and microvessels. **Peppiatt-Wildman** has pioneered the use of a live kidney slice model in renal research which has led to both strong publications from the School in *Nephron Physiology*, (recommended as being of special significance in its field by the F1000 Faculty; Pep03) *Acta Physiologica*, *Nephron Experimental Nephrology* and *Current Opinions in Nephrology, Hypertension* and substantial funding from Pfizer and Biogen to utilise this model in pharmacological research. **Wildman** has identified a renal sodium sensor involved in regulation of whole-body sodium balance and therefore blood pressure, work published in the top international renal journal (*Journal of the American Society of Nephrology*, Wil01) and was awarded a joint project grant from the Wellcome Trust in 2009 with Unwin at UCL, to bring together existing, and new, *in vivo* and *in vitro* experimental techniques to investigate local regulation mechanisms of key renal tubular transport mechanisms. **Baines**, with support from BHF, and in collaboration with colleagues from Imperial College and King's College,

Environment template (REF5)

London, has shown that deficiencies in the membrane-cytoskeletal adaptor protein 4.1R revealed bradycardia and long QT phenotype (Bai01 and Bai03). Together with Kelley (above) and **Loo** (below), this group seeks to consolidate renal and cardiovascular research at Medway in the next 5 years. Through KentHealth (see below), they have made collaborative links with specialist renal clinicians in Kent (see REF3b Urinary Imaging). Furthermore, their strong expertise in electrophysiology and imaging complements the work of the neuroscience group (above). Butrous is a clinician, a visiting Professor of Cardiopulmonary Sciences and Head of the Pulmonary Vascular Research Institute in the USA. Together with **Mathie**, he has established a formal collaborative centre with the Excellence Cluster in Cardio Pulmonary Systems in Giessen, Germany with shared postdoctoral researchers and PhD students and a number of joint publications in journals such as *Circulation* and *Am. J. Respiratory Critical Care Medicine*.

The Infectious Diseases & Allergy Theme comprises four academic staff, **Dr B Gibbs, Dr S Scott, Dr N Temperton and Dr V Sumbayev**. **Gibbs** and **Sumbayev** collaborate to investigate the role of hypoxia on hematopoietic cells and mast cells. They have shown for the first time that hypoxic signalling, while differentially regulated, is crucial for pro-inflammatory, pro-allergic and pro-leukaemic responses of human myeloid hematopoietic cells. Their work, supported by the Royal Society and Asthma UK, has led to a number of outputs in journals such as *International Journal of Biochemistry and Cell Biology*, *Small*, *Cell Research*, and *European Journal of Immunology* (Sum01 - Sum04, Gib02). The *European Journal of Immunology* paper was a featured article in the journal (Gib02). In particular, a notable output in *Small*, (Sum03) in collaboration with colleagues in Italy and Switzerland on the mechanism of action of gold nanoparticles and their potential use in treating both inflammation and more advanced myeloid diseases such as leukaemia, has led to collaborative links with a number of other academic groups, research institutions and SMEs (see REF3b Gold nanoparticles).

Scott's work on gene therapy related to prostate cancer, with colleagues in Sheffield was published in *Cancer Research* in 2011 (Sco04). Together with colleagues in Manchester, he was awarded a British Heart Foundation research grant in 2010 to enhance therapeutic gene expression in saphenous vein transplants for the treatment of atherosclerosis. **Temperton** has developed a large panel of influenza subtype H5 and H7 pseudotypes which were used by a consortium led by Professor Antonio Lanzavecchia to isolate and characterize a "super antibody" from donor plasma cells (work published in *Science* in 2011, Tem04). **Temperton** also facilitated the first vaccine industry-validation of the pseudotype-based neutralization assay for influenza H5N1 (published in *Vaccine*, Tem02). In 2011, **Temperton** and **Scott**, supported by the School of Pharmacy, established a Viral Pseudotype Unit to translate basic virus research into assays for the preclinical evaluation of vaccines, antivirals and therapeutic antibodies and acts as an interface between academia, industry, and animal and public health laboratories. **Prof D Brown's** work on protein structure using X-ray crystallography and identification of drug target sites, in particular on phosphodiesterases and kinases (Bro03), integrates with all three Biological Science themes.

Chemistry and Drug Delivery Group

In the Pharmaceutics & Drug Delivery Theme, **Dr T Ghafourian** uses computer modelling software to study the absorption, distribution and metabolism (ADMET) properties of drugs. Her work on the effect of formulation factors on skin absorption has led to the production of a large database which she has made available through the FP7 project, COSMOS. The results have helped lead to the development of a collaboration with Dr Alex Freitas in Computing at Kent, supported by the award of an EPSRC discipline hopping grant and a joint faculty studentship resulting in several outputs (e.g. Gha01, Gha03-04). **Dr A Nokhodchi's** work on drug delivery has led to over 50 outputs since 2008. In work published in *Pharmaceutical Research*, (Nok04) he has engineered mannitol to improve the performance of dry powder inhalations by up to 45% compared with existing inhalers on the market. Merck (Germany) has shown considerable interest in this project and at present are testing the engineered mannitol further, with a view to future development. **Nokhodchi's** research has also received substantial financial support from pharmaceutical companies such as TEVA.

In the Materials Science and Medicinal Chemistry Themes, **Dr A Edwards** research into the development of a new class of supramolecular hydrogels in collaboration with Prof Rein Ulijn at the University of Strathclyde, led to an article in *Chemical Science* in 2011 which featured on the front cover of the journal (Edw02). Her work on peptidomimetic foldamers in collaboration with colleagues in the UK, France and Denmark has been supported by regular beam time allocation

Environment template (REF5)

awards at the Diamond Light source (worth >£400K, including £77K new award in the summer of 2013) and led to a number of strong outputs. Together with **Dr V Gubala** and colleagues in Rouen, her work on the delivery of neuroactive peptides for therapeutic application within the PeReNE Interreg network received grant support from the European commission in 2012. **Gubala's** research on controlled release based on coated nanoparticles (Gub03) has also won recent support from the European commission. He also collaborates with **Sumbayev** and **Gibbs** on the design and study of gold nanoparticles (above and REF3b). Dr Nathalie Lavignac's collaborative research with **Dr S Richardson** and **Dr D Douroumis** in Greenwich School of Science, develops stimulus responsive polymers for intracellular delivery of biomacromolecules for the potential treatment of cancer, is supported by the Kent Cancer Trust and Genta and has resulted in publications in the *Journal of Controlled Release* (with **Richardson**, Gre292) and *Polymer Chemistry*.

Clinical and Professional Practice Group

Following the strategic appointment of **Prof Janet Krska** in 2011, to develop research in CPP, this group has developed its research interests in medicines optimisation and public health. In particular, their research focuses on cardiovascular and related diseases, mental health and neurological conditions. Whilst the plan for this group is to develop and generate sustainability over the next five years, they have already achieved notable successes. **Krska** has established research interests in adverse drug reactions (ADRs), the development and evaluation of novel pharmacy public health services and patients' experiences of medicines use. Her work in patient reporting of ADRs, published in *Drug Safety and Health Technology Assessment* (Krs01, Krs02) has been strengthened by a new collaboration with Exeter Medical School and the West Midlands Centre for adverse drug reactions and also continues in Thailand. New local collaborations are leading to a range of studies in both medicines optimisation and pharmacy public health services, involving several other staff in the School. **Krska's** novel scale, measuring the impact of using long-term medicines on quality of life, is proving of interest to researchers in several countries. **Dr R Loo's** research into the characterisation of the human metabolome using spectroscopic methods, straddles the boundary between laboratory and practice based research and is collaborative with colleagues at Imperial, Johns Hopkins University and in Chemistry at Greenwich and has led to the formation of the Medway Metabonomics Research Group. Her research has resulted in the introduction of 'metabolome wide association' study and generated very strong recent outputs, including papers in *Nature* (Loo01), *Analytical Chemistry* (Loo02, accepted as an accelerated paper) and the *American Journal of Epidemiology* (Loo03) and a prestigious MRC new investigator award to **Loo** in 2011. Most of the group are new to independent research and four are currently registered for PhD, with the first two (Thomas, Gill-Banham) due to complete in late 2013.

Staff in CPP regularly present work at national and international conferences and the group has been successful in attracting over £100K in research grant and enterprise income in 2012-2013, including awards to **Krska** from Lewisham PCT, Manfrin from Italian Pharmacy Organisations and **Krska** and Gammie from South London HIEC. The group has grown considerably since 2012 so that in addition to four staff registered for PhD, a further seven PhD students have registered in 2012/13 and the group is supported by a post-doctoral researcher. Both grant income and student numbers are expected to grow as more staff complete their PhD studies and become independent early career researchers.

c. People, including:

i. Staffing strategy and staff development

Staffing and Strategic appointments

Appointments of research active academic staff since the inception of the School have been in the three broad areas of Biological Sciences, Chemistry and Drug Delivery and Clinical and Professional Practice as these align with our research strategy going forward. Since 2008, a number of academic appointments have been made to augment existing areas of strength and to develop key strategic research areas across all three areas. Since 2008, BS has grown through the recruitment of **Ushkaryov** from Imperial, **Temperton** from UCL and **Wildman** and **Peppiatt-Wildman** from the Royal Veterinary College, London. CDD has recruited Cumming (from Industry), Hall from Sunderland and **Gubala** from Dublin. CPP has recruited **Loo** from Imperial and **Krska** from Liverpool John Moores as well as making a small number of teaching and scholarship appointments for staff with experience as practising pharmacists.

Staff development

The School fully supports the Concordat to support the career development of research

staff and research associates are offered identical contracts to academic staff. In 2013, the University of Kent received a European Commission HR Excellence in Research Award for its institutional arrangements for achieving the key principles of the Concordat. The School actively encourages researchers to return to academic research following career breaks. For example, Dr Xiaju Shi held a Daphne Jackson Trust Fellowship from 2009-2011 to allow her to return to academic research (in **Mathie's** laboratory) and teaching following a career break. She has continued in employment in the School after the end of the fellowship. A number of academic staff in clinical and professional practice who did not have a previous research background have been given the opportunity to develop their research through study for PhD. All new appointees to lecturer positions attend a compulsory PGCHE course which includes modules on developing as a researcher and developing as a research degree supervisor. All staff have workload allocation plans which support dedicated research time, include time for grant-writing and reward research activity. The school provides mentors for all new academic appointments.

Over-arching support for research staff is provided by the University of Kent and to augment support for both early and mid-career researchers and research associate staff, the University supports an Early Career Researchers Network with a specific chapter based at Medway (Medway Research Network), which runs an annual Research Festival for all research staff at Medway. As well as allowing early career researchers (including final year PhD students) from across the University to interact and form collaborations, it also provides a forum for career advice. To complement this, the University runs a "Grants Factory", a programme of grant writing support for staff applying for research funding with each session led by leading Kent academics with significant experience and success writing such applications.

The University of Kent's HR strategy and policies support the research environment through the effective recruitment, selection and induction of staff; good employment practices, including a mediation scheme and work/life balance initiatives; a promotions' process which recognises and rewards all aspects of academic excellence; and proactive equality and diversity initiatives, such as Athena SWAN and networks to support the individual equality strands, i.e. Gender, LGBT, Disability, BME. The University of Kent has joined and is committed to the principles of the Athena SWAN charter and has submitted its application for a bronze University-level award. Building on this we have created a working group which has already begun the work to enable an Athena SWAN School award submission to follow success at University level. Other internal providers support continuous professional development for research staff including Learning and Development (leadership programmes, generic skills, equality and diversity training), the Unit for the Enhancement of Learning and Teaching (accredited academic development programmes and academic continuous professional development, including specific content on researcher career development) and the Kent Graduate School.

ii. Research students

The School introduced a doctoral training programme in 2008, with our first intake of 11 students in October of that year. They joined the 3 existing PhD students in the School who had moved with their supervisors from previous locations. Our first full cohort graduated successfully in 2011-12 and all of them have gone onto further employment, most continuing their research careers working in laboratories in the USA (4), Sweden (2), Holland (1) and the UK (1). As of July 2013, the unit has had 23 successful PhD graduates with a 95% completion rate. Currently (October 2013) the School has a vibrant postgraduate research community with 37 registered PhD students. The school has a graduate studies committee, a Director of Graduate Studies (**Krska**) and dedicated administrative support to monitor postgraduate student progress and welfare. PhD students provide representatives for the School Research and Enterprise Committee and other appropriate committees. In addition to their research commitments and specialist research methods training provided by the School, all students can attend optional transferrable skills training provided by the University of Greenwich and all are members of the University of Kent Graduate School which provides both optional and compulsory elements of skills training in line with the Concordat. The Graduate School was established in 2008 and acts to enhance the quality of the postgraduate experience across the University through the provision of a researcher development programme (RDP) for all postgraduate research students and postdoctoral researchers and additional academic, social and networking opportunities. The RDP offers training and career development in line with the Researcher Development Framework. Our research students are encouraged, and supported financially, to present their work at national and

Environment template (REF5)

international conferences and a number (e.g. Al-Hamidi, Atkinson, De Santis, Newby) have won awards for the quality of their poster presentations.

Research studentships are funded in a variety of different ways. As well as School supported studentships, we have studentships funded by University of Kent 50th anniversary scholarships, University of Greenwich Vice-Chancellor studentships, studentships funded by KentHealth and Kent Cancer Trust, two BBSRC CASE studentships and an EPSRC CASE studentship. Several of these students share joint supervisors with other Schools in Kent (Biosciences; Physical Sciences, Computing, Centre for Health and Social Studies) or Greenwich (Science) both to enhance the student experience and career development and to encourage collaborations between different disciplines.

Going forward, our strategy is to maintain and expand our community of research students. Our introduction of a MSc in Applied Drug Discovery seeks to develop a clear career path between undergraduate degree and research training. We aim to increase the number of CASE studentships we obtain to maximise collaborative links with Industry and increase the number of joint studentships with other Schools and faculties.

d. Income, infrastructure and facilities

Following its inception in 2004, the School received support from the Universities of Kent and Greenwich to develop research infrastructure and strategically invested a significant percentage of its early income (>£4 million) to further develop research infrastructure. As a result, the BS and CDD Groups are housed in adjacent, recently refurbished laboratory suites totalling over 1000 m² on the ground, first and second floors of the Anson Building at Medway. Their close location maximises sharing of resources and collaboration. BS has dedicated state-of-the-art molecular biological (including quantitative real time PCR, FACs and an In-cell Western blot imaging system), tissue culture, electrophysiological and fluorescent microscopy facilities. CDD has dedicated state-of-the-art drug delivery, nanotechnology, spectroscopy, chromatography and organic synthesis facilities.

With 6.6 FTEs returned in RAE2008 in Kent through other units of assessment, MSOP has received all consequent QR funding (£300-£350K each year). This is used to fund PhD student fees and stipends, maintenance and upgrade of existing resources and small bids for new equipment. Within the Universities, the School has had several successful bids for funding from Kent's Science Faculty Research Fund and the University of Kent Catalyst Fund for Enterprise (**Wildman, Lall, Edwards, Temperton, Gibbs**, Lavignac, Kelley, Hall with awards totalling around £40K). The School has also successfully bid for research PhD studentships from the University of Kent 50th anniversary fund and the University of Greenwich VC fund, winning 10 awards to date.

The School benefits from access to confocal and electron microscopes housed in Biosciences at Kent (cemented through collaborative links with **Baines** and **Brown**) and specialist pharmaceutical sciences resources (CD, NMR, Mass Spectrometry, zetasizer) at the School of Science, University of Greenwich, immediately adjacent to the School, through collaborations with **Richardson** and **Douroumis**. Since 2010, **Edwards** has received regular awards to use the Diamond Light Source valued at >£400K. In 2008, the School established links with Charles River in Manston, Kent which allowed us to establish a laboratory there and carry out behavioural experiments and other procedures with small rodents under optimal conditions for animal welfare and experimental quality, allowing us to reduce and refine animal use. In 2013, the school expanded research infrastructure through significant investment in additional laboratory space and a multiphoton microscope and electrophysiological facility to enhance our *in vitro* and *in vivo* research capability.

Research grant income (spend) per annum has grown to >£600K in 2013 from a base of virtually zero prior to 2008 (REF4b). Our new research and enterprise award income has grown from £157K in 2007-2008 to £1,474K in 2012 – 2013. New grant awards in the last three years include support from MRC (£389K, **Loo**), BBSRC (£200K, **Mathie**), BHF (£51K, **Scott**), Royal Society (£159K, **Mathie**), Wellcome Trust (£80K, **Wildman**), Asthma Research UK (£49K, **Gibbs**), Pfizer (£530K, **Peppiatt-Wildman**), TEVA (£126K, **Nokhodchi**), NIH (£40K, **Scott**), EU (£80K, **Edwards/Gubala**), Kidney Research UK (£227K, **Wildman & Peppiatt-Wildman**).

Research Governance: All research in the School is monitored by the School's Research and Enterprise Committee which is chaired by the School Director of Research (currently **Mathie**; **Peppiatt-Wildman** took over as Director of Enterprise in 2013) and has representation from across the School and from Kent Health, Kent Research services and Kent Innovation and Enterprise.

Environment template (REF5)

This committee reports to the Faculty of Sciences Research and Enterprise committee at Kent which in turn reports to the University's Board for Research and Enterprise. Kent also runs a Directors of Research network which meets three times annually to provide training, development and opportunity for sharing of good practice across the university. The School has representation on the Faculty committee. Additionally, the School Research and Enterprise committee also reports to the University of Greenwich Research and Enterprise committee. The School ethics committee is a subcommittee of the Research and Enterprise committee and all research projects require ethical approval from this committee. Where required, research projects obtain NHS approval before commencement. All of these committees report to the Faculty of Science ethics committee at the University of Kent which acts as a forum for the sharing of best practice and ensures that research integrity is established at the heart of the University's research activities. The University's research ethics and governance officer guides and advises researchers on good research practice, ethical review and regulatory requirements, providing policy, guidance and training.

Management of Research grant applications and awards is governed by Kent Research services. This, the University's dedicated research support office, provides advice and training in developing, costing, negotiating and managing research grants, and more broadly in supporting the University's research culture. This includes facilitating interdisciplinary working, through regular 'PVC Lunchtime Seminars' and internal funding to support the development of large, complex and interdisciplinary projects; an Early Career Researcher Network, which encourages ECRs to meet those in other Schools and share good practice; and the award winning 'Grants Factory' programme, in which staff who have been involved with Research Councils and major charities provide help and advice to those with less experience. The University also has an Internal Peer Review system, where all grant applications to Research Councils, the EU and charities are appraised by at least two experienced academic staff, usually one within and one out-with the applicant's own school. All of these initiatives are supported by a comprehensive information service, utilising traditional and new media, such as surgeries in Schools, research funder visits, newsletters, email updates, Twitter, and a ground-breaking blog, 'Fundermentals'. Research impact development is supported by the University's Innovation & Enterprise (KIE) department which provides professional support to develop business collaborations for the purpose of exploiting research outputs for commercialisation, consultancy and training (see REF 3a).

e. Collaboration or contribution to the discipline or research base**Collaboration**

A key component of our research strategy is external collaboration. Indeed we believe that this is critical to our continued development. All academic staff members have collaborations with colleagues in academia both in the UK and abroad, with over 40 different collaborators in the UK, over 30 collaborators in 10 countries in Europe and also a number of collaborators in the USA, Australia, Thailand, Singapore, Iran, Israel and Uganda. At least as important, however, as a School of Pharmacy, are our collaborations with healthcare professionals and the pharmaceutical industry. All academic research staff in the School are members of KentHealth – the University of Kent's "one stop shop" for health and social care expertise. This has already extended our links with local health care providers such as Medway NHS Foundation Trust, Kent and Canterbury Hospital, East Kent Health and a number of local pharmacies. These expand on existing links with Health Care providers elsewhere in the UK. We also have links with several animal health care agencies including the World Organisation for Animal Health, the Animal Health Trust, the Animal Health and Veterinary Laboratories Agency, the Federal Research Institute for Animal Health (Germany) and the National Equine Centre (Ireland) and Public Health organisations such as the Health Protection Agency, the National Institute for Biological Standards and Control and the World Health Organisation.

A large number of research projects are done in collaboration with Industry, particularly the Pharmaceutical Industry. The School has active collaborations with over a dozen pharmaceutical companies from large multinationals to SMEs including Pfizer, GlaxoSmithKline, Merck, Novartis, Humabs, Ablynx, Boost Technologies, Izon Science, Alk Abello, Discovery Biomed Inc, Colorcon, Charles River, Takeda, Galleon Pharmaceuticals, Chiralabs, TEVA, Biogen and Laserchrom. A number of these companies already fund research carried out in the School (e.g. Pfizer, TEVA, Takeda, Biogen). Additionally, collaborations with industry have led to joint applications for funding and successful awards of a Royal Society Industry Fellowship, BBSRC Industrial Partnership

Environment template (REF5)

award and BBSRC and EPSRC CASE studentships. Exemplifying our links with industry, MSOP was a finalist in the 2013 UK Life Science Skills Awards as provider of the year for our Applied Bioscience Technology Foundation degree (see also REF3a) and one of our students on the degree, Natalie Webster, was a finalist for the 2013 Higher Apprentice of the year.

Contribution to Research Base

Pharmacy academics have acted on grant review panels or as grant reviewers for over 30 different organisations since 2008 including BBSRC, MRC, Wellcome Trust, Diabetes UK, Royal Society, Leverhulme Trust, BHF, NIHR, Research for Patient Benefit, BUPA, Kidney Research UK, Cancer Research UK, Deutsche Forschungsgemeinschaft (Germany), Agence Nationale de la Recherche (France), Förderung der Wissenschaftlichen Forschung (Austria), Telethon Fondazione (Italy), Swiss National Science Foundation Czech Science Foundation and the Flemish Research Foundation. Of particular note, **Gibbs** has served on a special emphasis NIH/NIAID panel in the USA. **Krska** was a member of the NIHR Research for Patient Benefit North West Committee (2010-2011). **Mathie** has served on the MRC College of Experts and Alzheimer's Research Trust Referee Panel and **Wildman** is a member of the East Kent Hospitals University NHS Foundation Trust Grants Scheme Committee.

Pharmacy staff have served on the editorial boards of several journals since 2008. For example, **Baines** is an editor of *Biochemical Journal*, **Edwards** an editor of *Advances in Chemistry*, **Gibbs** an editor of *Inflammation Research* and **Krska** an editor of *International Journal of Pharmacy Practice*. **Mathie** served as editor for *British Journal of Pharmacology* until 2011, **Nokhodchi** is Editor in Chief of the *British Journal of Pharmaceutical Research*, **Peppiatt-Wildman** is an assistant editor of *Frontiers in Renal and Epithelial Physiology*, **Ushkaryov** is a member of the editorial board for *Journal of Biological Chemistry* and **Wildman** is an associate editor for *Nephron Physiology*. In addition, pharmacy academics have reviewed papers for more than 80 different academic journals since 2008. A number of staff have acted as external PhD examiners both in the UK and abroad.

All pharmacy academic staff regularly communicate their research to a wide audience either as published works or as invited contributors or plenary speakers at National and International conferences. For example, in 2013, **Nokhodchi** received a prestigious award at the 18th Razi Research Festival on Medical Science in Iran for research based on published work in Pharmaceutical Science and **Ushkaryov** gave a plenary lecture at the Gordon Research Conference on Molecular Pharmacology in Barga, Italy. GRAC (REF3b) edited by **Mathie** has been described by the British Pharmacological Society as "a research tool...that it has made an important contribution to the maintenance and development of pharmacology as a discipline".

The expertise of Pharmacy staff is widely recognised externally. **Edwards** is a Royal Society of Chemistry Carbohydrate Group committee member and serves on a working group for an EU COST programme. **Gibbs** is a council member for the European Histamine Society, has been appointed Vice-President of the European Mast Cell and Basophil Research Network and serves on the UK management committee for 2 EU COST programmes. He was awarded Ausserplanmassiger Professor in "experimental allergology by the University of Lubeck in 2010. **Gubala** is a member of the IUPAC committee: Division of Chemistry and Human Health (Division VII). **Krska** was awarded a fellowship of the Royal Pharmaceutical Society in 2011 and is a member of their conference research panel. She was a member of the NorthWest Primary Care Pharmacy Research Group (2009-2011) and is currently a member of the Primary Care Research Network South East Board, a member of the steering committee, Prescribing and Research in Medicines Management and a committee member of the European chapter of the Special Interest Group of Drug Utilization Research of the International Society of Pharmacoepidemiology. **Mathie** was a member of the nomenclature committee for IUPHAR until 2011 and is now a corresponding member. He is also a Royal Society Industry Fellow and a Fellow of the British Pharmacological Society. **Temperton** is an advisor for the European Medicines Agency on serological assays for influenza viruses and is an elected member of the Medical Research Club. **Ushkaryov** serves on the board of the Adhesion GPCR consortium and was (until 2009) president of the British chapter of the Society for Neuroscience. He is a visiting Professor at Imperial College London. **Wildman** is a Fellow of the American Society of Nephrology.

In summary, the school has met its ambitions set out in its research strategy from 2008-2013 and is well placed to build on this success going forward.