Institution: University of Leicester

Unit of Assessment: UoA5 Biological Sciences

a. Context

Biological Sciences at the University of Leicester is a broad church, ranging from fundamental molecular studies of animal and plant cells through to applied research relevant to biomedical and ecological challenges. Biological sciences research at Leicester has made major contributions to improved quality of life in the UK, and globally, through delivering substantial economic, environmental, social and health benefits, perhaps the best-known example being the discovery and development of DNA fingerprinting in the 1980s by Prof. Sir Alec Jeffreys, which continues to have massive global impact.

The breadth and depth of internationally-competitive research at Leicester has provided the opportunity to support a wide-range of local, national and international beneficiaries, which have included communities, companies, non-governmental organisations, and local and national governments. For example, ongoing research on the affects of commercial agriculture on fresh water environments has supported the sustainable development and success of agriculture in both the UK and abroad by providing informed advice and guidance to farmers, communities, policy makers and commercial partners, such as supermarkets. This has secured the future for the Lake Naivasha region of Kenya (750,000 inhabitants) and the supply of cut flowers to European supermarkets (exports of ~ £260 million per year). Similarly, leading research expertise and infrastructure in all aspects of protein science has supported the very important biotechnology and pharmaceutical sector in the UK, with strategic partnerships (MRC Technology), close industrial collaborations (UCB Celltech) and University spin-out companies (Haemostatix) providing substantial contributions to successful drug discovery and development programmes. This willingness to engage in translational research partnerships with major biomedical charities (Wellcome Trust, Cancer Research UK and MRC Technology), healthcare, biotechnology and pharmaceutical companies has yielded very substantial economic and health care benefits over the assessment period, which have contributed to the success of major international companies, such as UCB Celltech (~ £3 billion revenue per year) and Abbot Medical Optics (~ £720 million revenue per year), and worldwide has directly benefited millions of people.

b. Approach to impact

Impact Culture and Landscape at Leicester: In common with many Universities across the UK the support for enterprise and impact-delivering activities at Leicester has been fairly limited until recently, with no overall strategy in place for Biological Sciences prior to 2011. Consequently, the approaches to translation of basic research activities and delivery of impact over the assessment period have mainly depended on the vision, enthusiasm and leadership of individual academics, with support from their research groups and colleagues. This “grass roots” approach to translation of biological research, development of collaborations with essential partners and productive engagement with potential beneficiaries has nevertheless resulted in a number of notable successes, which are described in the accompanying case studies. In addition, it has produced a growing number of very promising, pre-impact translational projects, such as a new approach to reducing the scarring associated with wound healing (led by **Pullar**) and a bacteriophage-based treatment for *C. difficile* infections (pioneered by **Clokie**).

The enterprise and impact agenda within Biological Sciences at Leicester has predominantly focussed on the translation of research findings and expertise to deliver economic, social and healthcare benefits. However, the genetics-focussed Centre for Excellence in Teaching and Learning (GENIE) has also instigated a wide range of **outreach** activities (~ 50 events each year, attracting up to 3,000 participants). For example, “Dynamic DNA” events have been run every year since 2006, providing ~ 600 13-14 year old children and ~ 50 teachers with the opportunity to engage with modern genetics, and raising their awareness of the exciting world of biological sciences and its ability to transform lives. GENIE also organises a very popular series of public engagement lectures designed to raise the awareness of biological sciences research and its implications for society.

A Partnership Approach to Impact Assessment and Delivery: Experience at Leicester suggests that realisation of the impact potential of biological sciences research often requires the formation of translational partnerships with external organisations, which brings together complementary expertise, knowledge and facilities. Another key factor is recognition of the potential benefits and value of new research findings, or of leading expertise in specific research areas, which is greatly facilitated by close working relationships with potential beneficiaries and user groups, such as commercial organisations, health care professionals and biomedical charities. The experience gained has strongly influenced the approaches used to build essential relationships and deliver impact, which are outlined below.

Industrial Engagement, Collaborations and Partnerships: One very effective pathway to impact has been the development of close collaborations and strategic partnerships with research groups from pharmaceutical and biotechnology companies that have shared research interests, and/or requirements for particular research expertise. In many cases these relationships have developed from informal contacts made following the publication of research papers, the presentation of recent work at scientific meetings, involvement in European Union research networks, or through shared colleagues and collaborators. An effective way of nurturing these translational partnerships and building trust on both sides has been through shared research students supported by schemes such as BBSRC and MRC CASE PhD studentships. For example, the very successful structural biology collaboration with UCB Celltech started in 1992 as a result of shared research interests and following **Carr**'s move to Leicester in 2001 has developed into a major structure-based drug discovery and development partnership, which has delivered substantial economic and healthcare benefits over the assessment period. Molecular pharmacology research groups at Leicester (**Challis** and colleagues) developed a comparable long-term partnership (~ 20 years) with GSK research groups based at the Harlow research centre, which made significant contributions to a number of drug discovery programmes. More recently, the development of a novel bacteriophage-based treatment for *C. difficile* infections will be pursued as a newly established partnership between **Clokie**'s group at Leicester and AmpliPhi Biosciences. This provides at least £190,000 for further research work at Leicester and has the potential to deliver substantial economic, social and health care benefits through a licence agreement between AmpliPhi and the University.

Biomedical Charity Engagement, Support and Partnerships: A number of the major biomedical charities, such as the Wellcome Trust and Cancer Research UK, have established excellent schemes to support the translation of basic research and have developed effective working relationships with the pharmaceutical, biotechnology and healthcare industries, and with clinical centres of excellence. At Leicester we have made extensive use of the expertise, contacts and financial support available through these biomedical charities to both assess and develop the impact potential of appropriate projects. To date, this has been particularly successful within the area of drug discovery and development. For example, with support from the Wellcome Trust Seeding Drug Discovery programme (~ £3.5 million) **Andrew**'s discovery of novel small molecule inhibitors of a bacterial protein required for the development of life threatening pneumococcal respiratory infections has been progressed to the point of a promising therapeutic candidate, which is very likely to lead to the formation of a new University spin-out company (Axendos) supported by £10-20 million of venture capital funding. Similarly, collaborative work between the structural biology group of **Bayliss** at Leicester and medicinal/computational chemists at the Institute of Cancer Research led by **Blagg** has resulted in the rational development of dual-specificity, therapeutically synergistic protein kinase inhibitors, which show great promise for the treatment of a number of human cancers.

Active engagement with the translational arms of major biomedical charities has been greatly facilitated by regular invitations to Leicester to discuss the support available and to assess potential projects with research group leaders. In 2012 this resulted in the formation of a new translational partnership with MRC Technology (£646,775 over the first 5 years) to provide structural biology support to their drug discovery and development programmes, which is led by **Carr** and **Bayliss** at Leicester.

Centre for Translational Therapeutics: To build on the growing success of Leicester groups in both

underpinning research and pre-clinical drug discovery, the University has recently established a Centre for Translational Therapeutics (CTT) to further support, encourage and coordinate these important impact generating activities. This initiative also aims to address the healthcare and economic issues raised by reduced commitment to pre-clinical and pre-competitive drug discovery by the pharmaceutical sector. The CTT houses a core group of experienced research scientists, with expertise covering cell biology and genetics (**Barber**), protein biochemistry (**Yeoh**) and structural biology (**Carr**), which provides strong support for proof of concept studies to allow successful development of new ideas and targets through to translational partnerships, as described above. For example, successful pilot work to assess the potential of anti-muscarinic receptor ligands in the treatment of schizophrenia (Prof. Tobin) has led to the establishment of a new partnership with Eli Lilly, which includes nearly £200,000 to support further studies.

External Experts, Advice and Support: To facilitate both the assessment of the potential impact of research work within Biological Sciences at Leicester and the successful interaction with potential translational partners and beneficiaries, we have started to build a small group of Leicester-associated external experts with substantial translational, industrial and commercial expertise. Members of this panel have agreed to provide advice on the commercial potential and value of new research discoveries, to suggest possible avenues for their development or exploitation, and to provide access to networks of professional contacts. This initiative has grown from successful translational collaborations and, to reflect the partnership relationship, external experts have been appointed to honorary Professor positions, which also highlights the standing and knowledge of the individuals. This panel now includes Prof. Martyn Robinson (former Vice President Antibody Biology, UCB Celltech) and Prof. Graham Boulnois (Partner, SV Life Sciences Advisers), who have provided valuable advice and guidance to a number of projects, including the pneumococcal drug discovery and wound healing programmes.

Coordinated University Support for Enterprise and Impact: The College of Medicine, Biological Sciences and Psychology (CMBSP) at Leicester developed a strategy for research-related enterprise and impact in 2011, which followed the reorganisation of its research activities into focussed, internationally-competitive Research Themes. The enterprise and impact activities are now coordinated and developed through an Enterprise Committee, chaired by **Carr**, which contains an enterprise "champion" from each Research Theme, with responsibility for disseminating ideas, raising awareness of potential opportunities and increasing the active involvement of research groups. This structure, together with increased support from the central Enterprise and Business Development Office (EBDO) of the University (see below), has provided Biological Sciences staff with an effective system to support the assessment of the impact potential of research and to access expert advice on possible translation pathways.

Coordination of the enterprise activities has also encouraged the Research Themes to organise impact-focussed events, such as a recent inspirational presentation from Prof. Goodfellow on how to set up a business. This has catalysed renewed interest in spin-out companies with several poised for launch in 2013/14, including Rutland Diagnostics and Axendos. The University have also provided targeted financial support for promising translational projects to provide proof of principle data, to protect intellectual property and to engage with potential partners. This has benefited a number of programmes within Biological Sciences including those led by **Tobin** (schizophrenia treatment), **Pullar** (wound healing) and **Clokie** (*C. difficile* therapy). Similarly, staff are now supported to realise the impact potential of their research by providing appropriate relief from other duties, such as teaching, which facilitates productive interactions with beneficiaries including secondment to industrial partners, as undertaken by **Kilvington** with Abbot Medical Optics (2008-2012). Overall, the recently implemented strategy to support translational work and impact delivery aims to encourage a very positive environment, in which these activities are strongly supported, highly valued and become a normal outcome of innovative research.

CMBSP also houses an embedded enterprise and business development centre known as the Biobator, which contains five staff from the University EBD office focussed on providing support for translational opportunities arising from primarily biological and medical research. This central support has been substantially strengthened recently by the appointment of two business

development managers, which for the first time provides strong support for the development of collaborations and partnerships with companies, translational charities and other potential beneficiaries, such as the Technology Strategy Board. This is particularly important and valuable for academic staff with no prior experience of assessing the potential impact of research and of translational activities, who can now be guided through the process, advised on potential partner organisations and assisted in meetings with potential collaborators or funding bodies. The Biobator also houses two experienced technology transfer and intellectual property managers, which provides excellent support and advice for this aspect of impact delivery, including the licencing of successful translational programmes to deliver economic, social and healthcare benefits.

c. Strategy and plans

The University have recently started to implement a very ambitious and positive enterprise and impact strategy, which has the vision to be recognised both locally and internationally as one of the leading UK universities for enterprise development, and for fostering a supportive enterprise and impact generating culture. This renewed commitment to translational activities, active engagement with potential research beneficiaries and delivery of impact, has already resulted in substantially increased EBDO support for Biological Sciences. To catalyse delivery of the enterprise and impact strategy the University has recently appointed a very experienced Director of EBDO, who has led the development of a detailed, user-focussed business plan, which was prepared in consultation with enterprise leads for the College and includes:
i) Restructuring and expansion of the central EBDO to produce teams appropriate to the support of enterprise and impact priorities in the individual Colleges, such as CMBSP.
ii) Strengthened leadership and management within EBDO to assist in setting ambitious but realistic targets (5-10% annual growth over the next 5 years), and to provide appropriate and timely support to academic and research staff.
iii) Enhanced and targeted support for early stage enterprise, translational and impact generating projects through University funded Proof of Concept and Prospect Funds.

In concert with the development of an overall enterprise and impact strategy for the University, CMBSP has taken a lead in developing a strategy to capitalise on the translational and impact potential of its internationally competitive research. This initiative is coordinated through the Enterprise Committee, which will lead in the development, implementation and support of research-led enterprise activities. This committee also acts as a key coordinator with the central EBDO support services and together with the Director of EBDO determines the priorities of staff within the Biobator. GENIE will continue to develop and coordinate the public engagement activities of Biological Sciences at Leicester, including the development of innovative web-based resources.

The strategy for successful translation of biological research and impact delivery is based on experience gained over many years and a diverse range of projects, with the involvement of translational partners an essential feature, as described above. Overall, we are striving to develop a very positive and supportive environment for a range of impact delivering activities, which will become highly valued, natural outcomes of innovative research. This will require increased advice, training and mentoring for academic staff with little experience in translational activities to date, which will be coordinated and delivered through the structures described above, with the Biobator-based EBD team and academic enterprise champions playing key roles. Our aim is to grow the number of successful partnerships, leading to economic, social and health benefits, and to significantly expand the number of staff actively involved in impact generating programmes.

d. Relationship to case studies

The impacts reported in the case studies were delivered in the absence of many of the support structures and approaches described in the previous sections and largely reflect the vision and determination of individual academics and research groups. The experience and knowledge gained through a diverse selection of impact delivering projects, together with advice from potential beneficiaries and translational partners, has strongly influenced and informed the approaches to impact, support mechanisms, strategies and plans, which have been implemented over recent years and have already benefited a number of exciting new programmes.