Research Assessment Exercise 2020
Impact Overview Statement

University: The Hong Kong Polytechnic University
Unit of Assessment (UoA): 1 Biological Sciences
Total number of eligible staff of the university in the UoA: Fifteen (15)

(a) Context

Our unit explores 2 research themes with human health impacts; 1: drug discovery & cancer (D&C) treatment, 2: food safety & technology (FST). Most projects in both themes focused on identification of target molecules that can protect against osteoporosis and those with anti-cancer activities. FST researchers also study the harmful effects of consumption of mercury and lead, microplastics and nano-silver that are present in our diets. We built the virtual *Food Safety & Technology Research Centre (FSTRC)* to support food-related projects. We have also grouped all drug-related development projects aimed at treating cancers into a virtual *Drug Development Research Platform (DDRP)*. For both platforms, the major non-academic beneficiaries of our research are relevant patient groups, the general public, companies (for licensing activities, including a global pharmaceutical (*Athenex*), a start-up (*PolyTom*)) and government bodies (such as the *Food & Health Bureau (FHB), Health Department (DH), the Agricultural, Fisheries & Conservation Department (AFCD), the Water Services Department (WSD)* through giving expert advice and evidence for making policy).

(b) Approach to impact

The core of our approach to impact is our ***interdisciplinary research focused on application***. Through our platforms, the department and university have funded impactful research projects and postgraduate studentships (e.g. *Dean's Reserve funding*, *Projects of Strategic Importance Fund* from PolyU). Such support has leveraged large-scale donations and additional government funding both locally and from Mainland China, funding levels that would have been difficult for staff to obtain individually. This enables us to magnify our research impact and invest in additional facilities critical to us and our industry partners to progress to commercial development. Our approach's success can be seen in the outcomes from: *T. Leung* and *T. Lo's* research on *arginase* (the first HK drug to receive *U.S. Food & Drug Administration IND* approval, providing statistically significant improved life expectancy for liver cancer patients); *L. Chow's* work on flavonoids (licensed to *Athenex* and contributing to their NASDAQ stock market listing and their hiring of 10 employees), and *KH Wong's* anti-cancer selenium nanoparticles extracted from *Tiger-Milk Mushroom* (licensed to *New Team International Enterprise Ltd*. for commercialization as a functional food with 4 employees hired to develop these products further). Royalties obtained were re-invested into the platform and further impactful projects in their early stages.

Our research approach directly engages with 3 sets of stakeholders:

***(1) Media and Public Engagement*:** Working with the *Head of Department*, *Departmental Research Committee* and colleagues in the *Communication and Public Affairs* office (CPA), we regularly publicize our impactful research results and enter *international invention competitions*. Our successes include: *K.H. Wong* (and *Y. Wang*) winning 2 gold medal invention awards in the 42nd *International Exhibition of Inventions in Geneva* (2014) for their project encapsulating liable flavonoids in food derived polymers. Hong Kong newspapers and social media (covering more than 80% of the 7 million population) reported the success. We built our reputation further through developing a pipeline of anti-cancer drugs locally (see Impact Case). Within this RAE period, 9 of our 15 staff have been covered by the media. We have also hosted symposia for industry partners and the CEOs of various pharmaceutical companies. Such media engagement and symposia promote our research achievements and generate collaboration, commercialization and donation opportunities. Funding obtained has been reinvested into impact-generating research.

***(2) Engaging with Government in Setting Public Policies*:** The above media strategy has raised public awareness of our research expertise and contributed to 4 team members (*S Lo, MS Wong, T Leung, KH Wong*) being invited to serve in government and official advisory groups (e.g. FHB, AFCD, *Council on Human Reproductive Technology*) shaping policies and guidelines. These involvements have directly contributed to Hong Kong policies regarding food supply standards, and

improved food safety regulations and practice. They have also informed decisions by health service and regulatory authorities on various new techniques regarding the field of human reproduction. Such involvement ensures our staff are up to date on areas of government concern with keen insight into resource deployment and future priority areas for research funding.

***(3) Engaging with Industries and Users in Government for Impactful Research*:** A core part of our approach is building and strengthening relationships with non-academics. We achieve this by: (a) soliciting expert insight *through our departmental advisory committee* incorporating key industry players (e.g. from Biotechnology, Food, Formula milk etc.) as well as members of Government bodies (e.g. *The Council of Testing & Certification* and *AFCD)* and charitable organizations (e.g. the *Hong Kong Jockey Club*); (b) partnering with *Athenex* since 2016 to host *Annual Biotechnology Forums* which bring together pharma CEOs, industry board members, investors and government officials for a full day program of key project presentations facilitating networking and collaboration; (c) supporting *consultancy projects* which provide easy launching points for long term collaborations. For example, WSD officials sought help regarding the frequent harmful algal blooms in HK reservoirs through a consultancy request. This was followed by HK Government funding for a technology demonstration project on the fabrication of a world-first mobile rapid algal biomass removal system (HK$1.78M). The WSD is now testing our device further in a large reservoir and a US provisional patent application has been filed. This project has been hailed a success story for allocation of public funding by the government.

Further commercialization: We encourage our colleagues to obtain patents and negotiate patents commercialization through *licensing* arrangements (see our Impact Case). Various PolyU colleagues (such as those from the *CPA* and *Innovation and Technology Development Office*) provide broad administrative support for our unit members.

(c) Strategy and plans

For the past 6 years, our strategy for impact has had 3 key aspects: (1) building (with internal resources) an optimal research environment for impact through the establishment and provision of our ***drug development research*** and ***FSTRC*** platforms (2) encouraging translational research through seed and matching funding schemes and (3) devising commercialization plans to support the use of IP and pathways to impact, as well as the generating of funding through consultancy income and collecting royalties. With the provision of a much expanded *Foshan campus* (3000 acres, about 20 times the size of HK PolyU campus), we will continue building on these 3 approaches in the coming RAE period through targeting 3 additional goals: (i) Intensifying our focus on the commercialization of our anti-cancer drugs and functional foods (see Environment Overview Statement) where the University will reward these drugs' inventors through established profit sharing schemes; (ii) Intensifying our research efforts in the ***FSTRC*** by hiring more talent to build and consolidate critical mass (including 3 Assistant Professors and one Research Assistant Professor in Food Science & Technology) and develop this Centre into a Research Institute; (iii) Establishing a Cell Therapy joint laboratory with a biotechnology company to support research in anti-cancer drug development.

(d) Relationship to case studies

Our impact story of drug candidates with anti-cancer potential is the result of interdisciplinary research with a focus on application between biologists and chemists, (see **Section (b)** above). This research is facilitated by the ***drug development research platform*** built specifically to research and develop anti-cancer drugs. This platform forms a marketing pack to pitch to funding agencies, prospective collaborators and partners and successfully obtain sizeable funding support. For example, our arginine depletion drugs research (see case study) started from a consultancy request leading to a partnership with a new start-up and eventually the drug candidates' clinical trial studies. Our strong initial results on the anti-arginine drug's performance on liver cancer patients were entered into international invention contests and our subsequent gold medals and grand prize attracted significant publicity. This media coverage directly led to a sponsor committing to a $2M annual donation for 10 years significantly pushing forward the second-generation drug's development and resulting in a new set of patents being obtained and licensed to other private companies. Royalties earned have been reinvested into other possible drug candidates in the platform powering the next development cycle.