The Physiological Society's response to the R&D roadmap survey

For more information about the inquiry, please visit: https://www.gov.uk/government/publications/uk-research-and-development-roadmap

Executive summary:

- In order to maximise knowledge and understanding through research, equal emphasis must be placed on both applied and fundamental research. Ensuring that the R&D pipeline is maintained throughout the innovation cycle will be crucial. Research and innovation rarely follow political timelines and applied knowledge can only be developed by understanding the mechanisms that underpin it.
- Physiological research makes a significant contribution to the UK economy. Research into cold water immersion from the University of Portsmouth has reduced the human cost of drowning which is estimated at £63 million per year. Similarly, stair falls are the leading cause of accidental death in older people. Falls on domestic stairs cause over 350,000 injuries to older UK residents each year, with personal consequences such as loss of independence, hospitalisation, and even death, not to mention £2 billion in demands on the NHS.
- Our research into knowledge exchange has demonstrated that physiological research has impact in areas beyond cutting-edge clinical settings. For example, research from our members at Manchester Metropolitan University has been used to inform public health guidance for older people's bone health and researchers at Liverpool John Moores University have been working with local authorities to develop home-based High Intensity Interval Training programmes designed to help those that are obese to lose weight without the need for access to private gyms or outdoor space.
- In order to meet the Government's commitment to 'enable regions right across the UK to realise their potential to drive innovation-led economic growth' and fulfil its objective to 'embed equality, diversity and inclusion at all levels', investment outside the Golden Triangle should be encouraged as a means to identify the most promising research and researchers from across the UK.
- Learned societies such as The Physiological Society are crucial in ensuring that researchers are able to collaborate effectively with partners and networks around the world. For example, The Physiological Society works closely with sister physiology societies throughout the world to ensure that this collaboration is able to take place. We work with European colleagues to organise biennial conferences aimed at bringing together scientists from across Europe and work closely with our sister organisations in Japan and North America given the number of researchers from those regions that successfully publish in our journals.
- There are a number of ways that government departments can engage with a wider range of voices to ensure R&D is delivering for society and inspire a whole new generation of researchers.
- The Physiological Society recently published an edition of its quarterly magazine Physiology News which noted that '29% of LGBTQ young people avoid careers in STEM because they fear discrimination, and those who do enrol are more likely to drop out (Hughes, 2018).

Consultation response:

1. How can we best increase knowledge and understanding through research, including by achieving bigger breakthroughs?

In order to maximise knowledge and understanding through research, equal emphasis must be placed on both applied and fundamental research. Ensuring that the R&D pipeline is maintained throughout the innovation cycle will be crucial. Research and innovation rarely follow political timelines and applied knowledge can only be developed by understanding the mechanisms that underpin it.

The Ageing Society Grand Challenge outlined as part of the 2017 Industrial Strategy is good example of this need for fundamental insight to develop scientifically rigorous interventions and products to help the Government meet the goal of 'five healthier, more independent years by 2035 while narrowing the gap between the richest and poorest'.

Current funding for the Industrial Strategy Grand Challenge mission for 'Ageing Society' has, to date, focused predominantly on applied innovation in manufacturing and engineering related to healthy ageing, particularly in the context of promoting the UK service sector overseas as a post-Brexit UK export to other economies with a significant ageing population such as China, India and Japan. As such, we are concerned that investment in the 'Ageing Society' Grand Challenge has focused on assisted living products and 'homes of the future, that are built to a standard suitable for the changing needs across a lifetime'[1]. While undoubtedly laudable aims, evidence from *Growing Older, Better,* The Physiological Society's report into healthy ageing, shows that these innovations will be insufficient to meet the Government's own 'five healthier, more independent years by 2035', nor will it likely reduce the significant inequality gap that exists between socio-economic groups. The R&D roadmap has the opportunity to set out ambitious goals to invest in cutting-edge research that could lead to the step change required in order to meet this goal. The Government's own target means engaging with people that are at least a decade away from the State Pension age as well as those who are experiencing age-related conditions. Understanding the mechanisms behind ageing and age-related decline caused by stresses such as obesity and inactivity will be crucial to improving the health and wealth of the nation in older age.

2. How can we maximise the economic, environmental and societal impact of research through effective application of new knowledge?

UKRI provides £213 million of funding per year for knowledge exchange (KE) via the Higher Education Innovation Fund (HEIF) to support and develop engagement between higher education institutions (HEIs) and the wider world, which results in benefits to the economy and society. HEIF provides a strong return on investment, with £9.30 generated for every £1 of funding[2].

The Physiological Society is currently undertaking a piece of research to better understand the specific contribution of physiology to this overall figure. While the data is yet to be finalised, we can say that anatomy and physiology attracted at least £12.9m of overseas investment in AY 2018/19[3].

In addition, Sport and Exercise Science makes a valuable contribution to the UK economy, not only in terms of the savings it makes for the health and social care system but also in its role as a significant driver of employment and economic growth. The Physiological Society demonstrated these economic and social impacts in its 2019 report *Sport and Exercise Science Education: Impact on the UK Economy.* The report's economic data found that Sport

[1] https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions#healthy-lives

[2] https://re.ukri.org/knowledge-exchange/the-higher-education-innovation-fund-heif/

[3] https://www.hesa.ac.uk/data-and-analysis/finances/table-5.csv

and Exercise Science higher education provision provides an impact of £3.9 billion in added income to the UK economy each year. This is equivalent to 147,300 jobs.

Furthermore, physiological research makes a significant contribution to the UK economy. Research into cold water immersion from the University of Portsmouth has reduced the human cost of drowning which is estimated at £63 million per year. Similarly, stair falls are the leading cause of accidental death in older people. Falls on domestic stairs cause over 350,000 injuries to older UK residents each year, with personal consequences such as loss of independence, hospitalisation, and even death, not to mention £2 billion in demands on the NHS. Sport and Exercise Science research is investigating the integrated relation of functional capabilities such as strength, balance, and cognitive status on causing stair falls.

It is pleasing to see that the Government has recognised the existence of the 'valley of death' between early-stage seed funding for commercialisation and more significant investment for research which has returned positive clinical trial data. This is a long-standing problem for researchers endeavouring to commercialise the outputs from their research and the Government should work with researchers to ensure that this is remedied through direct funding being made available or a risk-sharing mechanism for investment with the private sector.

Physiological research demonstrates that the effective application of new knowledge is already taking place in UK HEIs and having a tangible benefit on the economic and personal health of the UK. The R&D roadmap should seek to facilitate this with additional funding for both applied and fundamental sciences.

3. How can we encourage innovation and ensure it is used to greatest effect, not just in our cutting-edge industries, but right across the economy and throughout our public services?

The Physiological Society has recently been working to demonstrate the broad impact that innovation and research can have beyond the traditional understanding of academic impact in published articles.

Our research into knowledge exchange has demonstrated that physiological research has impact in areas beyond cutting-edge clinical settings. For example, research from our members at Manchester Metropolitan University has been used to inform public health guidance for older people's bone health and researchers at Liverpool John Moores University have been working with local authorities to develop home-based High Intensity Interval Training programmes designed to help those that are obese to lose weight without the need for access to private gyms or outdoor space.

As such, if the Government is serious about ensuring that innovation is used to greatest effect throughout the UK economy, it should ensure that the contribution of HEI's to knowledge exchange through the KEF is sufficiently broad and rewarded.

4. How can we attract, retain and develop talented and diverse people to R&D roles? How can we make R&D for everyone?

While support for homegrown R&D talent remains crucial, the Government's R&D roadmap also needs to recognise the need for an immigration system that facilitates the inclusion of staff from outside the UK. This includes not only the most prominent and promising scientists, but also the technical staff with the skills required to support the research base.

Also of note, the Parliamentary & Scientific Committee, the Royal Society of Biology and its member organisations, organise annual events such as *STEM for Britain* and *Voice of the Future* events, which promote the voices of Early Career Researchers (ECRs) in Parliament. The Government should seek to ensure that the opportunities such as these are used to develop and reward talented and diverse people to R&D roles by encouraging industry to get involved with initiatives such as these.

5. How should we ensure that R&D plays its fullest role in levelling up all over the UK?

The Government should consider the R&D roadmap as an opportunity to redress the balance of investment in historically underfunded regions and nations of the UK.

Innovation needs to happen everywhere people are, not just in certain historically successful regions of the UK. The Golden Triangle will undoubtedly remain hugely significant in UK R&D given its long-standing history as a centre for business and academic excellence. The South-East is connected by six of the top 20 busiest airports in the UK (including four of the top five) and receives a significantly large amount of infrastructure spend.

As a result, while short-term investment in London and the South-East of England is highly attractive, other regions of the UK have both short and long-term benefits for investors, for example, project costs are often lower outside the 'Golden Triangle'. It is right that R&D supports excellence in science but this should apply equally to excellence both within, and outside, the 'Golden Triangle'.

Ultimately, while The Physiological Society supports R&D spend in support of excellence in science regardless of its location, it is not sustainable in the medium- to long-term for R&D spend to be focused on the 'Golden Triangle' to the extent that it currently is. There is a ceiling on the number of suitable locations within the 'Golden Triangle' and this should be seen as an opportunity to diversify R&D spend across the UK.

In order to meet the Government's commitment to 'enable regions right across the UK to realise their potential to drive innovation-led economic growth' and fulfil its objective to 'embed equality, diversity and inclusion at all levels', investment outside the Golden Triangle should be encouraged as a means to identify the most promising research and researchers from across the UK. It should be noted that existing funds that have been established to encourage a small group of individuals, should take careful consideration of the need to increase the diversity of the UK science base. The Government must therefore ensure that its laudable objective to maintain the UK as a place of academic and research excellence should not be undermined by drawing from a small or homogenous talent pool.

6. How should we strengthen our research infrastructure and institutions in support of our vision?

Diversifying the UK's science base requires a joined-up approach with other aspects of the UK's infrastructure. In order for other science bases to flourish, they need to be supported by an appropriate supply of skills and education, as well as physical infrastructure such as transport links and broadband. R&D spend cannot exist in a vacuum and needs to be supported by other aspects of the UK economy.

7. How should we most effectively and safely collaborate with partners and networks around the globe?

Learned societies such as The Physiological Society are crucial in ensuring that researchers are able to collaborate effectively with partners and networks around the world. For example, The Physiological Society works closely with sister physiology societies throughout the world to ensure that this collaboration is able to take place. We work with European colleagues to organise biennial conferences aimed at bringing together scientists from across Europe and work closely with our sister organisations in Japan and North America given the number of researchers from those regions that successfully publish in our journals.

It is reassuring to see that the Government remains committed to 'close and friendly' collaboration with European partners following the end of the transition period at the end of this year and has committed to matching EU funding that would have been available to UK R&D through the Horizon Europe programme in the event that the UK is no longer able to participate in this programme. When we surveyed our members in 2017 about their biggest concerns about changes to the research base following the UK's departure from the European Union, 72% felt that their funding had already been affected or would be in future and access to EU funding was the most important thing members felt the Government needed to achieve for science as part of the Brexit negotiations.

8. How can we harness excitement about this vision, listen to a wider range of voices to ensure R&D is delivering for society, and inspire a whole new generation of scientists, researchers, technicians, engineers, and innovators?

There are a number of ways that government departments can engage with a wider range of voices to ensure R&D is delivering for society and inspire a whole new generation of researchers. In Parliament for example, the Commons Science & Tech Committee of the last two Parliaments have used the 'My Science Inquiry' call for proposals to invite members of the public and the science community to 'bid' for committee inquiry topics. Not only does this broaden the base of those aware of the Committee's work but also encouraged members of the public to create short video proposals – making the process of applying more dynamic and creative. The 2017-19 Parliament received over 80 submissions from topics as diverse as algorithms in decision making and e-cigarettes, demonstrating the breadth of public policy that involve STEM subjects. The Government should ensure that the R&D Roadmap recognises the challenges and areas of research that resonate with the public while at the same time communicating the value of other, less dramatic areas of research and public policymaking.

Additionally, the work of the APPG on Diversity in STEM demonstrates the need for the Government to do more to promote the work of historically underrepresented groups in STEM subjects. The Physiological Society recently published an edition of its quarterly magazine *Physiology News* which noted that '29% of LGBTQ young people avoid careers in STEM because they fear discrimination, and those who do enrol are more likely to drop out[4] (Hughes, 2018). 40% of LGBTQ people in STEM are not "out" at work'[5]. Meanwhile, BME men are 28% less likely to work in STEM than White men and that black men and women make up only 5% and 8% of students in STEM-based higher education respectively[6]. This disparity has a financial cost not only for the individual but for society as a whole, with the STEM skills shortage costing the UK £1.5bn by an estimate made by STEM Learning in 2018[7].

The Physiological Society has been working to promote a diversity of voices through its work with a commitment to 33% female participation and ideally gender equality across all our activities during the lifetime of our strategy to 2022. In recognition of this aim, The Physiological Society published *Women Physiologists: Centenary celebrations and beyond* which celebrates the significant contribution that female physiologists have made, and continue to make, in research. The Government must do more to celebrate and promote the contribution that individuals from underrepresented groups have made to UK science historically and set itself ambitious targets and actions to promote inclusion as part of the R&D roadmap.

[4] Hughes BE (2018). Coming out in STEM: factors affecting retention of sexual minority STEM students. Science Advances 4, eaao6373

[5] Yoder JB, Mattheis A (2016). Queer in STEM: workplace experiences reported in a national survey of LGBTQA individuals in science, technology, engineering, and mathematics careers. Journal of Homosexuality 63(1), 1 – 27.

[6] Campaign for Science and Engineering (CaSE), Improving Diversity in STEM, May 2014

[7] https://www.stem.org.uk/news-and-views/news/skills-shortage-costing-stem-sector-15bn