



Biotechnology and
Biological Sciences
Research Council

Frontier Bioscience ...the power of discovery

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Introduction...

BBSRC proudly supports a wide range of Frontier Bioscience: exciting and innovative research that pushes the frontiers of human knowledge and understanding.

Through pioneering and transformative basic bioscience, the UK's world-class researchers deliver valuable and robust new knowledge about living systems and how they function. These discoveries can go on to deliver great things through a range of trajectories of discovery, communication, collaboration, and application.

This booklet compiles some exciting examples of BBSRC funded Frontier Bioscience, its impacts and the ways in which it lays the foundation for future research delivering economic impact and social prosperity. We also share with you some snapshots of new frontier bioscience funded through our flagship responsive mode scheme...we're excited to see what that research may discover and where the new found understanding may lead.



Dr Amanda Collis,
Executive Director Research
Strategy and Programmes

Frontiers to health...

Oxygen is essential to living organisms. Without it, cells can't survive. But too much or too little oxygen can also be deadly.

Professor Sir Peter Ratcliffe and a team of researchers were awarded the 2019 Nobel Prize in medicine for their work revealing the mechanisms that control the cell's responses to changing oxygen levels. This research has delivered new knowledge of a basic aspect of how a cell works and has implications for treating various diseases in which delivery of oxygen to tissues is inadequate. The research illustrates the value of public funding for frontier bioscience, where solving scientific puzzles and delivering new knowledge leads to unanticipated impacts that benefit society.





Discovery to food security and clean energy...

Photosynthesis is a fundamental process on Earth, harnessing the energy of sunlight to drive the growth of plants, bacteria, and plankton generating the oxygen we breathe and the food we eat.

Professor Neil Hunter and his team are building on their frontier bioscience research that has developed a detailed understanding of how bacteria capture light and use it to power the living cell, to work towards developing novel and more efficient versions of photosynthesis. In the future this could lead to crop plants absorbing more solar energy, leading to increased food production, clean, unlimited energy and valuable chemicals from sunlight.



Fundamental bioscience to international development...

BBSRC funding supporting work utilising *Drosophila melanogaster* as a model system to understand cell polarity and cell fate in female and male germlines has led to the creation of a charity, DrosAfrica. This charity, founded Dr Isabel M Palacios, is helping to set up an African research community using *Drosophila* as a model system in biomedical science research. *Drosophila* is a powerful experimental model because it helps to efficiently decipher many fundamental processes that are conserved in mammals and allows for rapid, cheap and thorough screen of compounds in the search for disease treatments. DrosAfrica has helped create labs using this model system in countries where there were no efficient and inexpensive model system labs. They continue to facilitate workshops across Africa on *Drosophila* in bioscience research and are looking to create *Drosophila* centres that will allow African researchers to run projects with high impact in biomedical sciences.



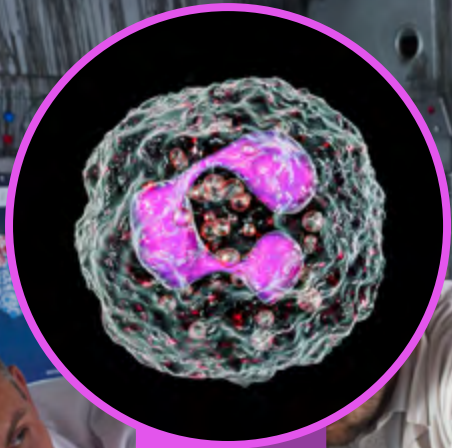


Frontiers to medicines discovery and diagnostics...

Funding from BBSRC has enabled Professor Jonathan Cooper and colleagues in the School of Engineering in the University of Glasgow to build on their cutting-edge frontier bioscience research in microtechnologies to develop advanced microfluidics sensors and systems. The team has embarked upon a trajectory of discovery science, from an understanding on how fluids move within tissues and cells to a series of new applications in the development of low cost medical and veterinary diagnostics, as well in new cutting-edge medical devices for new medicines discovery (Clyde Bioscience) and advanced drug delivery (Nebu~Flow).



Basic bioscience research to public engagement...



At the BBSRC strategically funded Babraham Institute, Dr Heidi Welch leads a team studying molecular mechanisms that control the Rac protein family which regulates cell shape, cell movement, oxygen radical formation and gene expression. PhD students within the lab, Elizabeth Hampson and Chiara Pantarelli, have worked to develop a public outreach program in the form of a cell 'escape room', an up-and-coming form of entertainment where participants must complete puzzles in order to escape a locked room. The room is based on the neutrophil signalling cascade studied by the Welch laboratory. The escape room has been showcased at the Cambridge Science and Latitude festival and has built public understanding and engagement with the basic bioscience and its role in human health.





Discovery to advances in engineering...

Ground-breaking research by Dr Huai-Ti Lin, from Imperial College London, is working to better understand the dynamics of insect flight. Hundreds of mechanosensors are present on insect wings and are vital for the insect's ability to respond quickly to the ever-changing environment during flight. Lin, through a combination of cutting-edge technology development and visionary thinking, will tease apart the role of mechanosensors in the flight of dragonflies, hawk moths and locusts. The understanding of mechanosensors in locomotor control will provide new knowledge relevant to all animal taxa. Increasing the fundamental knowledge of the process of flight could also lead to breakthroughs in the advancement of robotic technologies such as drone flight or self-driving cars, utilising mechanosensory information to become safer and more effective.






Frontier research to biofuels and added-value chemicals...

Promising technologies come out of strong frontier bioscience: through BBSRC funding and networks, Professor Kylie Vincent (Oxford University) has led pioneering work developing cleaner and more efficient biocatalysis used for the production of pharmaceutical molecules, agrochemicals, food flavour additives or chemicals for fragrances. Beginning as fundamental bio-inorganic chemistry looking at enzyme function funded through BBSRC's responsive mode, the approaches developed by Professor Vincent, Dr Holly Reeve and their team now have the potential to be scaled-up for use in the fine chemicals sector, and have been extended for selective introduction of the heavy hydrogen isotope, deuterium, into pharmaceuticals and other chemicals.





Basic bioscience to food security...



Professor Simon Avery and colleagues at the University of Nottingham have translated their discovery research using a yeast model to understand cell survival responses to stressors and population heterogeneity (individual cells responding in different ways). This has led to the development and commercial application of novel fungicides and biotechnological processes that combat food spoilage. Food spoilage by fungi is a major concern for global food security; up to one third of all foods is wasted due to fungi rendering them inedible and potentially toxic due to formation of substances termed mycotoxins. Through collaboration and partnership with industry, the knowledge uncovered through fundamental research funded by BBSRC has delivered strategies for protecting foods from fungi in both the agriculture and food and drink sectors.

Frontier bioscience delivering new knowledge

Examples of current research funded through BBSRC's flagship Responsive Mode scheme. Using cutting-edge research and technology to develop new understanding of...

...how environmental signals impact the phenotype of an organism via epigenetic modulation of the genome

...the 'plastome', the genome of the chloroplast

...how the suprachiasmatic nucleus generates and signals circadian rhythms to specific targets in the brain

...coloration and the interaction between pattern development and evolutionary function

... the mechanism and role of alternative splicing in plant developmental processes

...virus manipulation of host non-coding RNA regulatory networks

...prion formation in response to oxidative stress

...the molecular mechanisms employed by plants to protect themselves from excessive light

...nonclassical protein secretion by bacteria

...mitochondrial performance in real time

...the role of skill in animal contests

BBSRC invests in the future through funding exciting and innovative ideas that push the frontiers of human knowledge.



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Useful links:

Frontier Bioscience:

<https://bbsrc.ukri.org/research/frontier-bioscience>

BBSRC funding:

<https://bbsrc.ukri.org/funding/grants/>

BBSRC Big Ideas Pipeline:

<https://bbsrc.ukri.org/news/policy/2019/190611-n-bioscience-big-ideas-pipeline/>

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