Institute
for Life Sciences

UNIVERSITY OF
Southampton

Institute for Life Sciences

Annual Report

In this report

Since its inception the IfLS has seen a tremendously exciting level of interdisciplinary activity. Set up to catalyse collaborations between disciplines allied to biosciences, health and medicine, new research projects have blossomed into funded activities, targeting key areas of societal interest. This annual report gives a snapshot of new projects, current activities and targeted growth.

We now have a robust institute that brings individuals together; a collaborative network encompassing local government and enterprise; and exemplified by the new FortisNet hub centred on musculoskeletal challenges.

Driven by research excellence we are engaging in graduate education through new masters courses and doctoral training; have our own cohort of 32 students; and recently participated in the launch of the Biomedical Masters programme in collaboration with Engineering and Environment.

The next year offers us exciting opportunities, with life sciences and clinical translation becoming an ever more relevant component of the University's future.

Professor Peter J S Smith
Director, Institute for Life Sciences

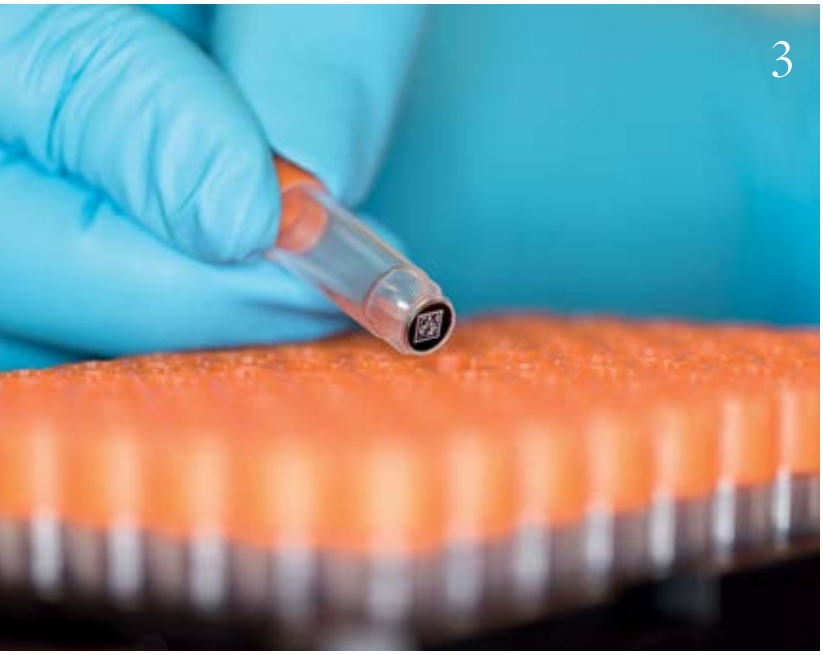
This annual report provides a compelling record of some of the outstanding research undertaken by members of the University of Southampton's Institute for Life Sciences. Work conducted by IfLS researchers contributes greatly to the University's international reputation for excellence in interdisciplinary life sciences, and to building strong, sustainable, collaborative partnerships.

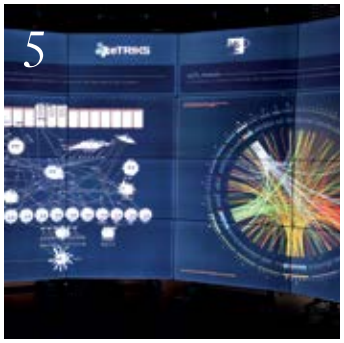
With its focused and dedicated aim to develop unique collaborations with health and societal impacts, the IfLS is already helping to change the world for the better. Its objectives are well aligned with the University's strategic priorities. We have a shared vision for engagement with global markets and for building strong partnerships with other world-leading institutions.

Professor Sir Christopher Snowden
President and Vice-Chancellor
University of Southampton

Cover image: Computed tomography of a simulated residual limb.

Image courtesy of: Professor Liudi Jiang and μ-VIS X-Ray Imaging Centre





More highlights

Motion analysis technology is used to understand the causes of injury and the development of osteoarthritis during sport and exercise.

Image courtesy of:
Dr Martin Warner
Image credit: Jon Banfield

"No single group or research team has all the expertise. The problems users face are so complex and multifaceted that we really need to pull in all the expertise for the delivery of new technology."

Dr David Moser, Head of Research, Blatchford

FortisNet – tackling society's musculoskeletal challenges together

The growing number of people with hard and soft tissue impairment, such as fractures, joint failure and limb loss, is set to be one of the great healthcare technology challenges of the coming decades.

Globally, the number of diabetic amputations is rising – in the USA there are estimated to be more than 70,000 diabetes-related amputations each year; in India this figure is approximately 40,000 and in the UK is 7,000.

Major developments in assistive technologies are required to ensure these people receive effective and targeted healthcare and are able to live their lives as fully as possible, with similar issues surrounding frailty and conflict amputees.

The Institute for Life Sciences (IfLS) is driving forward interdisciplinary research that will address these challenges with the recent launch of the pioneering FortisNet network.

FortisNet – a regional hub of expertise

FortisNet brings together leading academics and industry experts to develop a unique, collaborative, interdisciplinary network in hard (bone and teeth) and soft (skin, muscle, cartilage) tissue research.

It was created following an IfLS-commissioned audit of life sciences in the central southern region that revealed a tremendous concentration of interdisciplinary capability in regenerative medicine, orthopaedics, prosthetics and assistive technologies.

FortisNet aims to bring together this expertise to develop a regional specialisation in musculoskeletal challenges, create jobs, attract new businesses and retain skilled graduates within the region.

IfLS Director Professor Peter J S Smith said: "At Southampton we recognise that to truly tackle and find solutions to the major problems facing our society today, we have to collaborate with experts from around the UK, and across the globe, to make a real difference.

"With FortisNet we want to build on the skills we already have at Southampton to create an effective pipeline of product development for stronger, active bodies. We aim to develop a hub of expertise that will connect us with end-users, and other regional, national and international excellence in clinical practice, academic research and enterprise."

Translating research into commercial applications

FortisNet has already attracted a wide range of members from across academia and industry and has been working closely with Local Enterprise Partnerships, councils and commercialisation experts to ensure that the clinical needs of end-users are driving academic research and enterprise opportunities into usable, beneficial, effective devices.

Professor Peter J S Smith, Director, Institute for Life Sciences

Main image:
Computed tomography of a simulated residual limb.

Image courtesy of: Professor Liudi Jiang and μ-VIS X-Ray Imaging Centre

Inset right:
Representative images showing false colour sections through proximal femur of male sheep on different control and protein treatments. Low density bone is shown magenta, medium density is shown green, and high density bone is shown yellow/orange.

Image courtesy of: Professor Richard Oreffo and Dr Stuart Lanham, Bone and Joint Research Group, Centre for Human Development, Stem Cells and Regeneration

Peter Birkett, Chief Executive of Southampton Science Park (SSP), and David Bream, Director of SETsquared, were both involved in the launch of FortisNet and believe that their organisations can play a vital role in helping translate research into commercial applications.

Peter said: "Bringing academia and business together to work as a team is utterly fundamental in solving the problem of transitioning research into the marketplace and FortisNet is a really visionary project to try and achieve that.

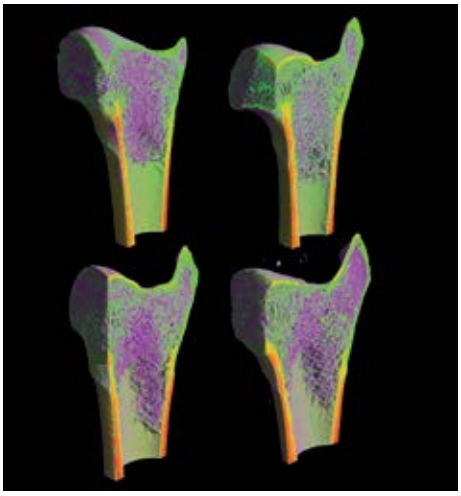
"The Science Park can contribute on a number of levels; together we can produce some really exciting science and technology businesses with potentially global impact."

David added: "I am genuinely excited by the opportunities FortisNet offers and the chance to work with leading-edge scientists, clinicians, surgeons and engineers, to identify those ideas that have got real commercial potential. We have the opportunity as a community of entrepreneurs to bring a whole cluster of businesses forward."

Dr David Moser, Head of Research at rehabilitation provider Blatchford, is one of a number of experts who can highlight the challenges industry is facing. He said: "It is very important for us to set out what we need to design better products for amputees. No single group or research team has all the expertise. The problems users face are so complex and multifaceted that we really need to pull in all the expertise for the delivery of new technology."

A unique perspective

Another network member – the Ministry of Defence – aims to offer a different end-user perspective to FortisNet.



Dr Ruth Turk (Health Sciences) showing the similarity between EMG (electromyography) and MMG (mechanomyography) signals. MMG with inertial sensors will be used in a new wearable device to support home-based arm rehabilitation after stroke.

Photo credit: Jon Banfield

Dr Julie Greeves, Research Director at Army HQ, explained: "We have a unique view about the requirements of the end-users in the area of prosthetics and preventative medicine.

"As an employer we want to drive down the risk and rate of injuries we observe in the army.

"By working with FortisNet, we will be working with a red brick institution that we can be confident will bring in the best scientists and the best technology to ensure the research will be of a very high quality and provide a holistic approach."

Making an impact

FortisNet is already beginning to make an impact. Royal Academy of Engineering (RAEng) Research Fellow and IfLS member Dr Alex Dickinson is working with colleagues Dr Peter Worsley and Dr Maggie Donovan-Hall in Health Sciences to investigate the potential of their research being used in low and middle income countries (LMICs).

Thanks to support from FortisNet, the team has been awarded EPSRC Global Challenges Research Funding to explore how they could enable clinical services to take innovative imaging technology to remote communities.

Alex said: "We have developed techniques to extract information from the scans of a patient's residual limb that let us measure how the limb shape changes over time, and produce design tools to ensure prosthetics last a lot longer and are more comfortable for the wearer.

"This funding will allow us to produce a proof of concept that could be used by industry to take this technology out to people in LMICs who otherwise wouldn't be able to access prosthetic clinics."

Alex and his team have also been invited to lead a session at the Rehabilitation International World Congress, in Edinburgh, this autumn, explaining the potential impact of their research and promoting the creation of FortisNet as a hub of expertise and a model for societal impact that could be replicated in other areas across the globe.

The conference is held once every four years and sees the world's leading disability experts gather to create a more inclusive, accessible world for all.

The future

FortisNet aims to form a central network in the area of musculoskeletal research for the whole nation.

Professor Peter J S Smith said: "By bringing the stakeholder groups together we are creating a really substantial hub for this kind of research with spokes reaching out across the country. This is a really exciting opportunity for the groups involved."

To find out more about FortisNet visit: **www.southampton.ac.uk/fortisnet**

Enhanced Perception: Seeing the world in higher resolution

The University of Southampton is at the forefront of the global imaging revolution that is seeing emerging technologies controlling light in the electromagnetic spectrum.

As well as being home to a broad range of conventional imaging techniques, the University is also advancing innovative technologies to help academics and industry find solutions to a variety of today's research questions.

From 2D, 3D and 4D imaging to microscopy research at the nanometre scale, Southampton's work has the potential to make a significant impact in many areas, particularly in the field of biosciences.

Imaging to the nanoscale

Southampton's cross-campus Nanoscope project involves IfLS researchers leading interdisciplinary imaging research that applies new physical discoveries to the biological sciences. The Nanoscope is an enabling technology for research across the life sciences, allowing novel observations to be made.

The IfLS team has been working with Southampton's Optoelectronics Research Centre (ORC) to develop a new type of unlabelled super-resolution microscope for biology and medicine.

The super-oscillatory microscope uses specially-designed lenses that engineer light to form very small spots allowing imaging to occur below the supposed limits set by the wavelength of light. This gives access for the first time to label-free, non-invasive imaging of living systems, demonstrating a resolution three times better than conventional microscopes.

Lead researcher Dr Edward Rogers said: "Our new type of microscope allows super-resolution imaging of living cells, but without the need for fluorescent tags. So now we can see these images in far greater detail without having to expose at high energy light levels, fix the cells, or carry out the extensive sample preparation needed for electron microscopy."

Southampton researchers are continuing to work on developing both the fundamental physics and the technology of super-oscillations for applications outside bio-imaging with the Nanyang Technological University, in Singapore.

The team is exploring improving the next generation of computer hard drives, and manufacturing future electronic and optical circuits.

Emerging imaging technologies

IfLS researchers are also at the forefront of developing novel multiphoton and non-linear imaging technologies that are translatable to the clinic. Their sub-cellular resolution and high sensitivity provides 3D chemical and structure-specific information in real-time and without any phototoxic effects.

These emerging technologies allow non-invasive, label-free imaging of molecules such as lipids, collagen, DNA and drugs.

A recent European Research Council grant has allowed the setting up of multimodal microscopes in the IfLS that are being extensively used in a variety of biological and medical studies.

Collaborating with industry

IfLS scientists have been using these emerging technologies to work with the Government's Defence Science and Technology Laboratory (Dstl), at Porton Down.

Dstl has been collaborating with Southampton's Biomedical Imaging Unit (BIU) and using multimodal microscopes in the BioNanoPhotonics Group, to develop research into understanding the action of drugs and viruses within tissues and cells. They are also exploring the potential of future work with the Nanoscope project.

These cutting-edge facilities are helping them understand more about the uptake of these viruses and drugs and their effect in humans and animal models.

The partnership grew from an IfLS symposium on non-conventional imaging, enabling colleagues from the University and Dstl to work together to further their research. They are advancing this collaborative relationship for the long term and are planning joint bids for large-scale research programmes.

Dr Caroline Rowland, a Principal Scientist at Dstl and IfLS Affiliate Member, said: "Southampton has extensive imaging capabilities that can benefit us in our research into the detection of viruses, bacteria and drugs within cells and tissues and examining the effects of chemicals on tissues and cells. The IfLS has been very proactive in establishing this collaboration between ourselves and the University to carry out research that is exploring the disease processes caused by chemical exposure and infection and is helping us understand how novel and existing therapies can affect these disease processes.

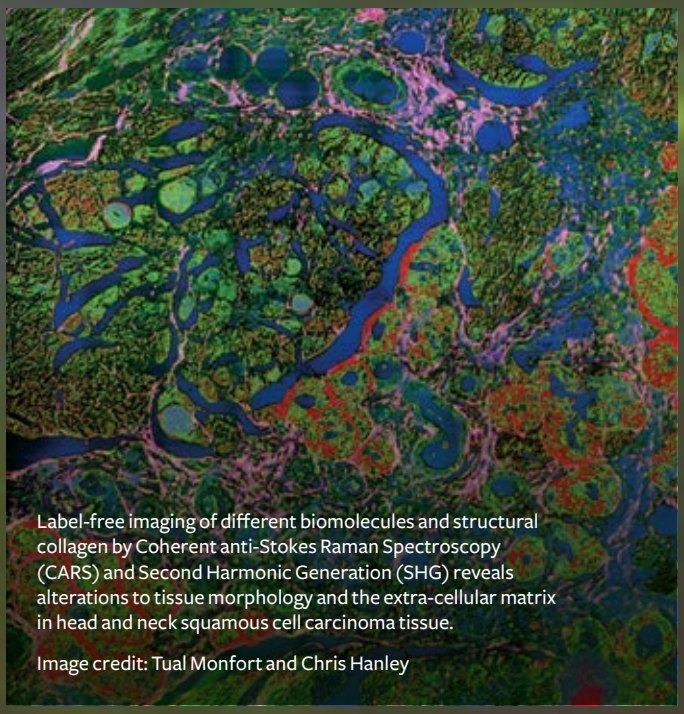
"By using the non-invasive technologies available at Southampton, we can more precisely understand the mechanisms of disease and the effectiveness of therapies for future use in humans. This will help in the development of novel treatment approaches including the delivery of antibiotics and their uptake into tissue cells. Following the non-conventional imaging symposium and some EPSRC Institutional Award funding, Southampton researchers also developed a collaboration to use Dstl's Imagestream facility. This has allowed high-throughput imaging of stem cells involved in bone fracture repair which has already contributed to a publication."

Anton Page, Head of the BIU, said: "We run one of the leading imaging units in the UK and have been able to use our facilities to generate images from the tissue specimens Dstl have provided us with. The application of fluorescent labels allows us to create 3D datasets that can show us the location of the drugs or viruses in the tissue sample."

To find out more visit: **www.southampton.ac.uk/ifls/lifetechnologies**

"The palette of existing and emerging imaging technologies at Southampton offers incredible opportunities for collaborations. IfLS researchers, together with ORC colleagues, are applying, tailoring and developing technologies to address the problems and questions posed by the industry scientists."

Dr Sumeet Mahajan, Head of the BioNanoPhotonics Group and IfLS Lead on Imaging



Label-free imaging of different biomolecules and structural collagen by Coherent anti-Stokes Raman Spectroscopy (CARS) and Second Harmonic Generation (SHG) reveals alterations to tissue morphology and the extra-cellular matrix in head and neck squamous cell carcinoma tissue.

Image credit: Tual Monfort and Chris Hanley

An apochromatic super-oscillatory lens developed in collaboration with Nanyang Technological University. Simultaneous research on fundamental science and biological applications has allowed the development of these new imaging technologies.

Image credit: Edward Rogers (UoS), Yuan Guanghui (NTU), Nikolay Zheludev (UoS & NTU)

"Interfaces with chemistry, computing and engineering are key growth points for our knowledge about cancer and how to treat it more effectively. We have been very excited by the ideas that have come forward to our joint initiative with the IfLS and look forward to seeing many more in the future: they can literally change the way we look at problems in cancer biology."

Peter Johnson,
Professor of Medical Oncology
Cancer Research UK Centre, Southampton

Barcoded DNA storage for tracking samples in the lab.

Image courtesy of: Professor Sarah Ennis, Genomic Informatics Group
Image credit: Jon Banfield

Facilitating innovative improvements in patient treatment and prognosis

Southampton's Institute for Life Sciences (IfLS) is enhancing its culture of interdisciplinarity by facilitating innovative collaborations that are making an impact on today's healthcare.

From Next Generation Sequencing (NGS) to the global fight against cancer, the IfLS is bringing together scientists from across different disciplines to enable new pathways to health.

Focusing on Next Generation Sequencing

Next Generation Sequencing is arguably one of the most significant recent technological advances in biological sciences.

Southampton has a growing national profile in this clinical genomics sector and, in collaboration with the Southampton University Hospital NHS Foundation Trust, was selected to be one of the first recruitment centres for the Genomics England 100,000 Genomes Project.

The pioneering project offers patients across the Wessex region the opportunity to be part of ambitious research to introduce genomic technology into mainstream healthcare.

The University is building on this reputation and the IfLS has supported and helped enable Southampton's Broad Interest Next Generation Sequencing (BINGS) network to focus on the future potential of the technology.

BINGS recently held a very successful symposium exploring the latest applications of DNA sequencing techniques and how NGS is becoming integrated into routine diagnostic use.

Organiser Sarah Ennis, IfLS member and Professor of Genomics at the University of Southampton, said: "The applications of high throughput sequence technology are expanding daily, and this is reflected by the growing number of attendees at our symposium each year."

More than 200 scientists from across the Wessex region gathered at the annual BINGS symposium to hear about sequencing viruses such as Zika and samples within oceanic Antarctic ice, to the current progress towards new high throughput sequencing technologies.

Sarah added: "It was exciting to bring together so many individuals working at the cutting-edge of their respective diverse fields to share ideas."

The University of Southampton has recently invested in a NextSeq sequencing machine and the Iridis 4 supercomputer that enables the high performance computing required for the efficient processing of next generation genomic data. Medicine at Southampton also launched an MSc in Genomic Medicine in 2015, which is aimed at a wide range of clinicians, scientists and researchers across southern England.

The battle against cancer

Cancer Research UK (CRUK) funding is supporting interdisciplinary work by IfLS researchers that is already showing potential impact in fighting cancer.

Five projects have so far received CRUK development money to explore a variety of methods to create new tools and treatments that will lead to better diagnosis, prognosis and management of cancers.

A project involving the development of a microfluidic platform to understand the potential interaction between the different cells in the tumour environment has already been demonstrated and used to secure follow-on external funding from major pharmaceutical company GlaxoSmithKline (GSK).

Project lead Dr Jonathan West said: "The CRUK funds have been vital in allowing us to demonstrate the feasibility of our technology for profiling the complex communication network within the diverse tumour microenvironment.

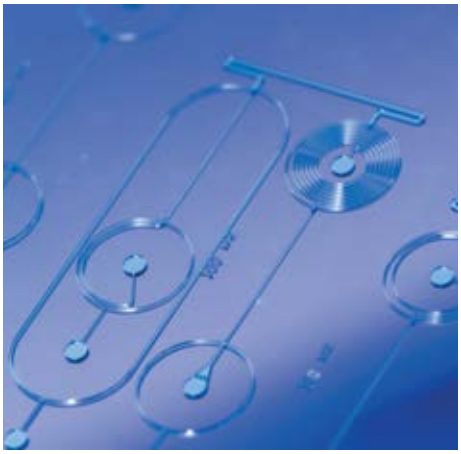
"This information could be used to see how immunotherapies affect the tumour cell population and ultimately to improve patient treatment and prognosis."

Other projects include the topology of breast cancer genomes and exploring cancer antibody therapy.

Professor of Molecular Oncology Graham Packham said: "The CRUK funding is enabling a very impressive range of projects. It has allowed us to put together interdisciplinary teams from across the University to investigate these pilot projects.

"This interdisciplinary working is a very important way forward for the development of medicine and healthcare and is seeing expert scientists from engineering, medicine, biology, mathematics and chemistry working together to further their research."

To find out more visit:
www.southampton.ac.uk/ifls/newpathwaystohealth



Microfluidic circuits for time-resolved systems biology: unravelling the mechanisms behind the origins of cancer.

Image courtesy of: Dr Jonathan West
Image credit: Jon Banfield

An integrative view of coping with environmental change

Climate change and global warming are having a significant detrimental effect on our environment, endangering whole ecosystems that a large number of other species rely upon for their survival.

Interdisciplinary research at the University of Southampton is exploring how ecosystems have the potential to survive these environmental changes and still deliver their invaluable support services to human societies.

Understanding the effect of environmental stress

Research by academics from Ocean and Earth Science, Biological Sciences and Medicine, supported by the Institute for Life Sciences (IfLS), is revealing more about the effect of these environmental stresses by applying cutting-edge technology to study the stress tolerance of microalgae.

The team, led by Dr Cecilia D'Angelo, a Senior Research Fellow with the Coral Reef Laboratory in Ocean and Earth Science, includes researchers from the University's Centre for Biomedical Research Mass Spectrometry Unit at Southampton General Hospital, and the interdisciplinary Centre for Nuclear Magnetic Resonance (NMR), to understand how algae living in symbiosis with reef corals can adapt to thermal stress.

An integrative approach

Cecilia said: "In Southampton, we are in a unique position to exploit synergisms arising from the use of biomedical state-of-the-art technology in environmental research to help understand how the corals cope with environmental stress.

"The sudden increase in ocean temperatures associated with the 2016 El Niño climate phenomenon induced high levels of coral mortality in coral reefs around the world due to the breakdown of the relationship between the corals and their algal symbionts. The process is called 'coral bleaching' as the loss of the algal partner results in a white appearance of the corals.

"We need to understand the physiological responses of these key species to environmental stress, to predict to what extent ecosystems can adapt to climate change."

Cecilia's team has been using Next Generation Sequencing (NGS) to shed light on the genomic make-up of microalgae, allowing some monitoring of the algal responses to environmental stimuli. However, there are limitations of this method in this context, so they are also exploring a number of other analytical techniques to reveal the bigger picture and look at cells in an integrative way.

She added: "We are exposing corals to simulated environmental stress in our experimental coral aquarium system and will then analyse the effects of this stress on the working of the organism with our colleagues at the NMR and Mass Spectrometry Unit."

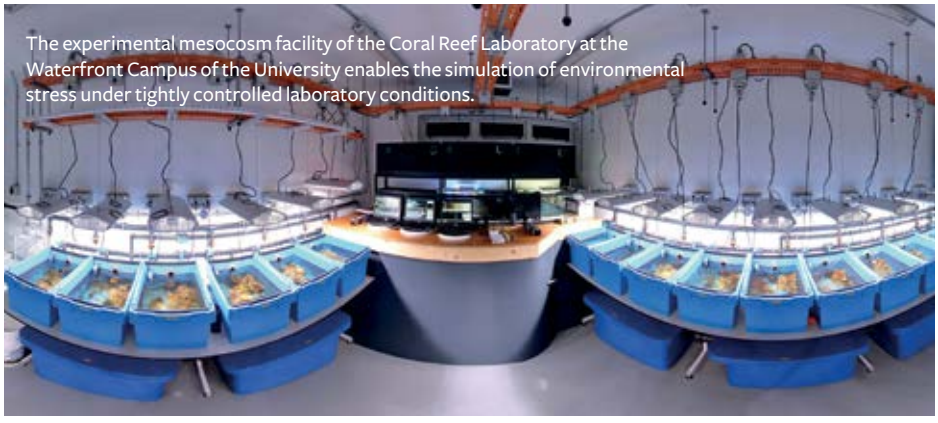
Interdisciplinary collaboration

Head of the University's Biomedical Research Mass Spectrometry Unit Professor Tony Postle said: "Southampton hosts one of the major lipidomics research groups in the UK. We are equipped with a state-of-the-art mass spectrometry facility that could provide the key to understanding cells in an integrative way. Applying our technology to Cecilia's work could answer many pressing questions in environmental research."

Associate Professor Dr Jörn Werner, from the interdisciplinary NMR Centre, said: "A multimillion pound investment in the NMR laboratory at Southampton has enabled unparalleled insights into cellular composition at the molecular level. The approach we are taking assesses the inner workings of the coral symbiont and how this relates to its health. The methods we employ are broadly applicable, not only in environmental sciences, but also in biomedicine such as the characterisation of cancer cells or even for the diagnosis of diseases in patients."

Initial findings have recently been published in Nature's International Society for Microbial Ecology Journal: *D'Angelo et al (2015) The ISME Journal 9, 2551-2560*, and rated by the Faculty of 1000. Visit http://f1000.com/prime/725504042

To find out more visit: **www.southampton.ac.uk/ifls/globalchange**



The experimental mesocosm facility of the Coral Reef Laboratory at the Waterfront Campus of the University enables the simulation of environmental stress under tightly controlled laboratory conditions.

Stony corals live in symbiosis with unicellular algae that lend their brownish colour to the corals' appearance. This *Acropora* coral shows the 'bleaching' effect of environmental stress disrupting the symbiosis, causing the corals to lose their brownish colour along with the algal partners.

Data exploration: Discovering the jewels of new knowledge

Over the last decade our lives have been transformed by a global explosion in data generation.

One of the biggest challenges facing society today is how to fully harness the potential of these complex and often large datasets by developing innovative methods for extracting, analysing and visualising information.

Southampton's Institute for Life Sciences (IfLS) is helping realise the full impact of these datasets by joining with the Web Science Institute and others across the University of Southampton and elsewhere to facilitate interdisciplinary collaborations that are exploring the integration of social and medical data.

Health and societal issues

To date two events have been held bringing together data experts to consider real-world, complex issues and explore how these large heterogeneous datasets can be analysed and used to tackle these challenges.

The first conference focused on environmental disasters and the use of geographical data gained from natural disasters in Bangladesh and Nepal. Delegates analysed this information to develop tools to aid disaster response. They looked at the benefits this data access could have in helping first responders analyse the situation faster than those on the ground.

The second event explored the theme of asthma and considered how datasets could deliver novel insights into detecting the symptoms of severe asthma and personalising healthcare to the individual patient.

The event was held at the Data Science Institute, Imperial College London, and provided an exciting and innovative, interdisciplinary environment for diverse teams from web science, medical research, data science, life sciences, mathematics, social sciences and bioinformatics to discuss how teams could work to effectively analyse these datasets and translate them into potential real-world applications.

The University of Southampton is renowned as a centre of excellence for asthma research and is part of the European initiative U-BIOPRED that uses information and samples from adults and children to learn more about the different types of severe asthma to ensure better diagnosis and treatment for each person.

Professor Ratko Djukanovic is Director of Southampton's NIHR Respiratory Biomedical Research Unit and leads Southampton's U-BIOPRED research. He said: "This conference was a wonderful event and I look forward to working in the near future with web scientists to provide a bigger, social dimension to our biomedical data on asthma and our understanding of this disease."

The future

The team hopes that the data events will engage a broader audience with the analytics of big data and data science, and catalyse them into developing new ways of analysing, understanding, and utilising this data.

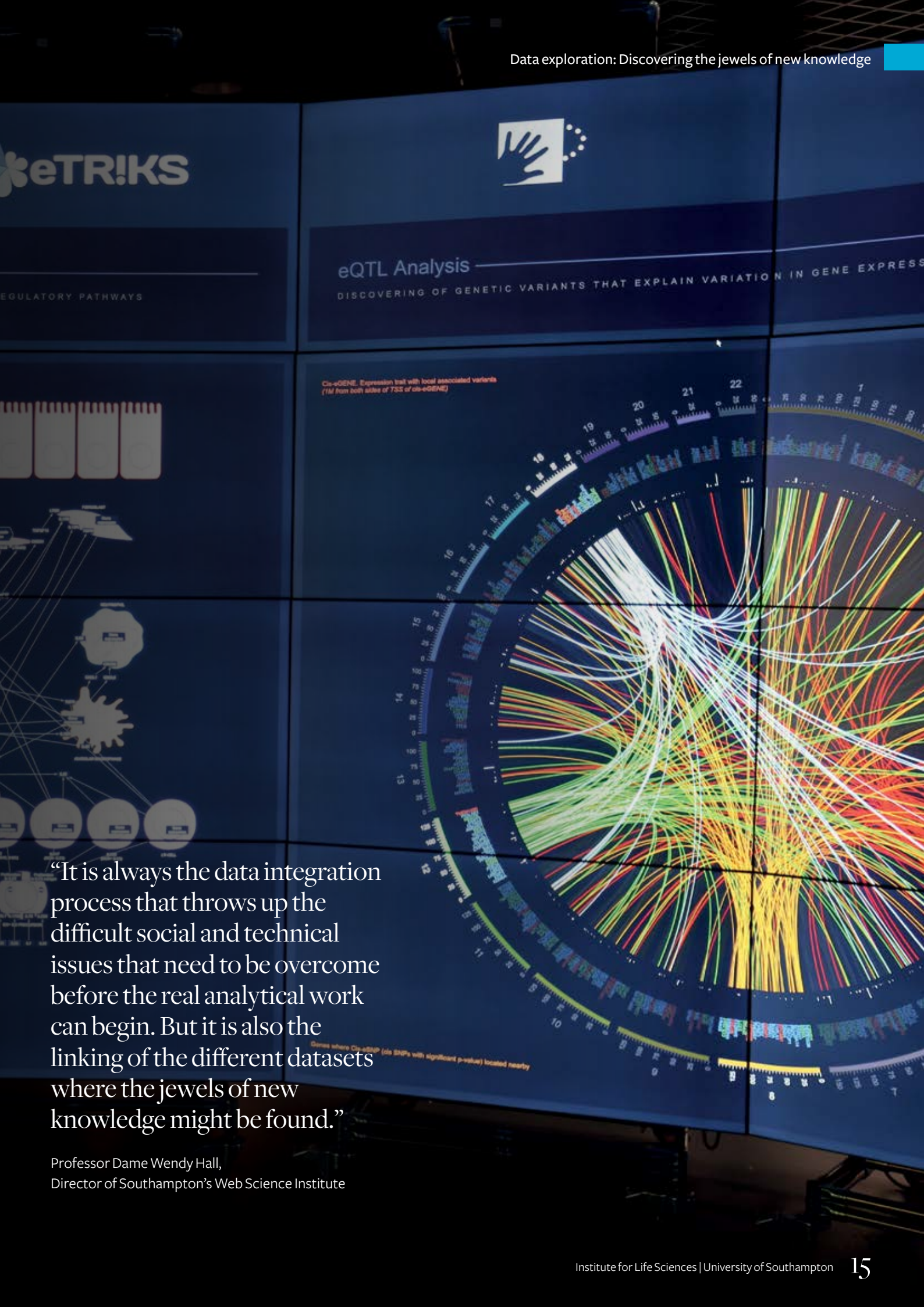
Professor Peter J S Smith, Director of the IfLS, said: "These data sessions have been a unique opportunity to bring together diverse minds to consider complex datasets and the challenges of assimilating different formats."

Professor Yike Guo, Professor of Computing Science at Imperial College and founding Director of the Data Science Institute, added: "Through this event, we have successfully established a concrete social machine model in healthcare. We are keen to further develop this important research and to build a close collaboration with Southampton in data science research."

To find out more visit:
www.southampton.ac.uk/ifls/humannexus

KPMG Data Observatory Facility, Imperial College London.

Image courtesy of: Professor Yike Guo, Data Science Institute, Imperial College London



"It is always the data integration process that throws up the difficult social and technical issues that need to be overcome before the real analytical work can begin. But it is also the linking of the different datasets where the jewels of new knowledge might be found."

Professor Dame Wendy Hall,
Director of Southampton's Web Science Institute

In brief

IfLS plays a key role in the development of a new masters degree programme

The Institute for Life Sciences (IfLS), in collaboration with Engineering and the Environment, has been instrumental in the development of a new engineering degree.

Students on the new MSc in Biomedical Engineering will study at the interface of engineering, biology and medicine, combining engineering expertise with an understanding of human biology and medical needs to help solve problems and provide effective solutions to the medical and healthcare challenges facing society.

They will gain the essential interdisciplinary skills required to allow them to take on leading roles in developing novel engineering solutions for healthcare practitioners. These solutions will improve or maintain health and well-being by creating better preventative, diagnostic, prognostic, restorative, rehabilitative and palliative measures.

Dr Sumeet Mahajan, Associate Professor in the Life Science Interface at the IfLS, said: "This is the first time the IfLS has been involved in helping to develop a programme of study. This new degree serves as an exemplar of cross-faculty teaching with the programme being run by academic staff from across many areas of the University."

www.southampton.ac.uk/ifls/educationtraining

New Doctoral Training Partnership in Translational Immunology

Collaboration between Southampton and Queen Mary University of London (QMUL) has resulted in significant funding to launch a new Doctoral Training Partnership (DTP) in Translational Immunology.

The two organisations bid against strong competition from other institutions across the UK to be awarded funding in excess of £1.4m from the Medical Research Council (MRC).

Dr Jane Collins is the Director of the four-year DTP that will fund five MRC students per year for three years. A further four students will be funded by the Institute for Life Sciences , the University of Southampton and QMUL.

The research will focus on using knowledge of the immune system to translate laboratory discoveries into new therapies to improve health, well-being and quality of life.

Jane said: "We are very excited at the opportunity to work with scientists at Queen Mary's to enhance the training of our graduate students in new bioinformatic technologies that will underpin future success. The application of these important approaches will strengthen our ability to make key discoveries in disease research."

Studying at the interface of electronics and life sciences

Students on Southampton's new BEng and MEng Biomedical Electronic Engineering degrees will get the opportunity to work alongside globally-renowned researchers from the Institute for Life Sciences (IfLS).

The unique programme is at the interface of electronics and life sciences and aims to help educate a new generation of engineers, exploiting state-of-the-art electronic engineering to develop innovative medical and healthcare technologies.

Students will learn the principles of electronics and biomedicine, and develop their practical skills and teamwork in the UK's leading electronics laboratories.

Professor Hywel Morgan, Professor of Bioelectronics and Deputy Director of the IfLS, said: "With an ageing population and an increase in chronic disease exerting a growing pressure on healthcare providers, we need to ensure we are training people with the skills required to develop innovative digital healthcare solutions such as home monitoring and intelligent diagnostics and treatment."

The programme will be run by Electronics and Computer Science and will launch in 2017.

IfLS PhD student Tao Wang

Social networks inform obesity and health

Novel research by a Southampton postgraduate student is exploring how social networks can be used to investigate the spread of eating disorders such as obesity.

Obesity has manifested itself into an epidemic over the past 30 years and is a major contributor to the global burden of disease. There is limited information about the spread patterns of the condition, although past studies have highlighted the role of peers and social networks in increasing the number of people with the disorder.

Tao Wang, from China, has received an Institute for Life Sciences (IfLS) and ESRC Doctoral Training Centre research studentship to carry out interdisciplinary research across the different disciplines of social sciences, and electronics and computer science, on *Obesity and health over social networks.*

He said: "This project is a combination of complex systems, health economics and computer science, and explores the spread of lifestyle-related health conditions over social networks. We are using data analysis to filter large datasets of Tweets collecting data related to obesity.

"The project members have different backgrounds in physics, economics and computer science. This communication benefits and develops my way of thinking and I really enjoy the mix of ideas from different disciplines."

The research has already established an effective framework to analyse the differences between people with eating disorders and the general population on Twitter.

Supervisor Dr Antonella Ianni said: "This research lays the basis for a deeper understanding of the social aspects of obesity and aims to build statistical tools that can help us use social network data to predict the risk of the occurrence of the condition, before its onset. It has already led to some interesting qualitative and quantitative results on other eating disorders such as anorexia and bulimia nervosa."

To find out more visit: **www.southampton.ac.uk/ifls/ourstudents**

The Institute for Life Sciences Conference, Precision Cancer Medicine: Forefront Technologies at the Clinical Interface, is taking place in September 2017, at the University of Southampton.

More information is available at
www.southampton.ac.uk/ifls/conference2017

Microfluidic replica mould: disseminating single cell droplet sequencing technology to the biomedical community.

Image courtesy of: Dr Jonathan West
Image credit: Jon Banfield

A sample of publications from our members: 2015–2016

The Institute is a catalyst for interdisciplinary research and training. Working across the University campuses and the regional community, we aim to develop our collaborative models and address key societal issues and enterprise opportunities. The sample of publications is a selection from many hundreds produced by our members and illustrate the type of research being carried out under our strategic goals.

New Pathways to Health

Allan RN et al (2016)
Low concentrations of nitric oxide modulate Streptococcus pneumoniae biofilm metabolism and antibiotic tolerance.
Antimicrob. Agents Chemother. 60(4): 2456-2466. (doi:10.1128/AAC.02432-15)

Bisht K et al (2016)
Dark microglia: a new phenotype predominantly associated with pathological states.
Glia 64: 826-839. (doi:10.1002/glia.22966)

Blunt MD et al (2015)
The PI3K/mTOR inhibitor PF-04691502 induces apoptosis and inhibits microenvironmental signaling in CLL and the Eμ-TCL1 mouse model.
Blood 125(26): 4032-4041. (doi:10.1182/blood-2014-11-610329)

Collins J, Lane S, Merriman-Jones J and Jones KT (2015)
DNA damage induces a meiotic arrest in mouse oocytes mediated by the spindle assembly checkpoint.
Nat. Commun. 6(8553): 1-12. (doi:10.1038/ncomms9553)

Hanson M and Godfrey KM (2015)
Genetics: Epigenetic mechanisms underlying type 2 diabetes mellitus.
Nat. Rev. Endocrinol. 11: 261–263. (doi:10.1038/nrendo.2015.31)

Hinks TSC et al (2015)
Innate and adaptive T cells in asthmatic patients: Relationship to severity and disease mechanisms.
J. Allergy Clin. Immunol. 136(2): 323-333. (doi:10.1016/j.jaci.2015.01.014)

Hydes T et al (2015)
Natural killer cell maturation markers in the human liver and expansion of an NKG2C+KIR+ population.
The Lancet 385(S1): S45. (doi:10.1016/S0140-6736(15)60360-9)

Janeczek AA et al (2015)
Transient canonical Wnt stimulation enriches human bone marrow mononuclear cell isolates for osteoprogenitors.
Stem Cells 34: 418-430. (doi:10.1002/stem.2241)

Lai C et al (2015)
Characteristics of immunosuppressive regulatory T cells in cutaneous squamous cell carcinomas and role in metastasis.
The Lancet 385(S1): S59. (doi:10.1016/S0140-6736(15)60374-9)

Noorani I et al (2015)
Novel association between microglia and stem cells in human gliomas: A contributor to tumour proliferation?
J. Path: Clin. Res. 1: 67–75. (doi:10.1002/CJP2.7)

Olmos-Alonso A et al (2016)
Pharmacological targeting of CSF1R inhibits microglial proliferation and prevents the progression of Alzheimer's-like pathology.
Brain 139: 891-907. (doi:10.1093/brain/awv379)

Paquet C et al (2015)
Effect of active Aβ immunotherapy on neurons in human Alzheimer's disease.
J. Pathol. 235(5):721-730. (doi:10.1002/path.4491)

Shah M et al (2015)
Local origins impart conserved bone type-related differences in human osteoblast behaviour.
European Cells & Materials 4(29): 155-176.

Tebruegge M et al (2015)
Mycobacteria-specific cytokine responses detect tuberculosis Infection and distinguish latent from active tuberculosis.
Am. J. Respir. Crit. Care Med. 192(4): 485-499. (doi:10.1164/rccm.201501-0059OC)

Widdows KL et al (2015)
Integration of computational modeling with membrane transport studies reveals new insights into amino acid exchange transport mechanisms.
The FASEB Journal 29(6): 2583-2594. (doi:10.1096/fj.14.267773)

Zekonyte J et al (2015)
Quantification of molecular interactions between ApoE, amyloid-beta (Aβ) and laminin: Relevance to accumulation of Aβ in Alzheimer's disease.
Biochim. Biophys. Acta 1862(5): 1047-1053. (doi:10.1016/j.bbadis.2015.08.025)

Life Technologies

Ahluwallia BS et al (2015)
Squeezing red blood cells on an optical waveguide to monitor cell deformability during blood storage.
Analyst 140: 223-229. (doi:10.1039/c4an01181c)

Blume C et al (2015)
Temporal monitoring of differentiated human airway epithelial cells using microfluidics.
PLoS One 10(10): e0139872. (doi:10.1371/journal.pone.0139872)

Carugo D et al (2015)
Spatiotemporal dynamics of doxorubicin elution from embolic beads within a microfluidic network.
J. Control Release 214: 62-75. (doi:10.1016/j.jconrel.2015.07.003)

Daly KR, Keyes SD, Masum S and Roose T (2016)
Image-based modelling of nutrient movement in and around the rhizosphere.
J. Exp. Bot. 67(4): 1059-1070. (doi:10.1093/jxb/erv544)

He PJW, Katis IN, Eason RW and Sones CL (2015)
Engineering fluidic delays in paper-based devices using laser direct-writing
Lab Chip 15: 4054-4061. (doi:10.1039/c5lc00590f)

Kalsi S et al (2015)
Rapid and sensitive detection of antibiotic resistance on a programmable digital microfluidic platform.
Lab Chip 15: 3065-3075. (doi:10.1039/c5lc00462d)

Lamb S et al (2015)
Exercises to improve function of the rheumatoid hand (SARAH): a randomised controlled trial.
The Lancet 385(9966): 421–429. (doi:10.1016/S0140-6736(14)60998-3)

Liebi M et al (2015)
Nanostructure surveys of macroscopic specimens by small-angle scattering tensor tomography.
Nature 527: 349–352. (doi:10.1038/nature16056)

Meron D, Hedger N, Garner M and Baldwin DS (2015)
Transcranial direct current stimulation (tDCS) in the treatment of depression: Systematic review and meta-analysis of efficacy and tolerability.
Neurosci Biobehav Rev. 57: 46-62. (doi:10.1016/j.neubiorev.2015.07.012)

Rushworth CM et al (2015)
On-chip cavity-enhanced absorption spectroscopy using a white light-emitting diode and polymer mirrors.
Lab Chip 15: 711-717. (doi:10.1039/C4LC01264J)

Russ KA et al (2016)
C60 fullerene localization and membrane interactions in RAW 264.7 immortalized mouse macrophages.
Nanoscale 8(7): 4134-4144. (doi:10.1039/c5nr07003a)

Saha SC et al (2015)
Characterization of the prokaryotic sodium channel NavSp pore with a microfluidic bilayer platform.
PLoS ONE 10(7): e0131286. (doi:10.1371/journal.pone.0131286)

Smus JP et al (2015)
Tracking adipogenic differentiation of skeletal stem cells by label-free chemically selective imaging.
Chem. Sci. 6: 7089-7096. (doi:10.1039/C5SC02168E)

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Structural basis of ligand binding to UDP-galactopyranose mutase from Mycobacterium tuberculosis using substrate and tetrafluorinated substrate analogues.
J. Am. Chem. Soc.137(3): 1230–1244. (doi:10.1021/ja511204p)

Strahl H et al (2015)
Membrane recognition and dynamics of the RNA degradosome.
PLoS Genet. 11(2): e1004961. (doi:10.1371/journal.pgen.1004961)

Global Change: Systems and Cycles

Amano T, Coverdale R, and Peh KS-H (2016)
The importance of globalisation in driving the introduction and establishment of alien species in Europe.
Ecography (doi:10.1111/ecog.01893)

Dick GJ and Lam P (2015)
Omic approaches to microbial geochemistry.
Elements 11(6): 403-408. (doi:10.2113/gselements.11.6.403)

Gittins JR et al (2015)
Fluorescent protein-mediated colour polymorphism in reef corals: multicopy genes extend the adaptation/acclimatization potential to variable light environments.
Mol. Ecol. 24: 453–465. (doi:10.1111/mec.13041)

Hawkins SJ, Bohn K and Doncaster CP (2015)
Ecosystems: the rocky road to regime-shift indicators.
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Methods Ecol. Evol. 6: 764–771. (doi.10.1111/2041-210X.12378)

Martínez-Botí MA et al (2015)
Plio-Pleistocene climate sensitivity evaluated using high-resolution CO2 records.
Nature 518: 49–54. (doi:10.1038/nature14145)

Rädecker N et al (2015)
Nitrogen cycling in corals: the key to understanding holobiont functioning?
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Snow JT et al (2015)
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Global Biogeochem. Cycles 29: 865–884. (doi:10.1002/2015GB005090)

Solan M et al (2016)
Anthropogenic sources of underwater sound can modify how sediment-dwelling invertebrates mediate ecosystem properties.
Scientific Reports 6: 20540. (doi:10.1038/srep20540)

Tamiru M et al (2016)
A chloroplast-localized protein LESION AND LAMINA BENDING affects defence and growth responses in rice.
New Phytol. 210(4): 1282-1297. (doi:10.1111/nph.13864)

Zhang K, Dearing JA, Tong SL and Hughes TP (2016)
China's degraded environment enters a new normal.
Trends Ecol. Evol. 31(3): 175-177. (doi:10.1016/j.tree.2015.12.002)

Human Nexus

Chapman MA, Hiscock SJ and Filatov DA (2016)
The genomic bases of morphological divergence and reproductive isolation driven by ecological speciation in Senecio (Asteraceae).
J. Evol. Biol. 29: 98–113. (doi:10.1111/jeb.12765)

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The effect of early, comprehensive genomic testing on clinical care in neonatal diabetes: an international cohort study.
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Stat. Methods Med. Res. 24(3): 342-372. (doi:10.1177/0962280214520732)

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Rass-Somssich MI et al (2015)
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Longitudinal copy number, whole exome and targeted deep sequencing of 'good risk' IGHV-mutated CLL patients with progressive disease.
Leukemia. 30(6): 1301-1310. (doi:10.1038/leu.2016.10)

Tomechko SE et al (2015)
Proteomic and bioinformatics profile of paired human alveolar macrophages and peripheral blood monocytes.
Proteomics 15(22): 3797-3805. (doi:10.1002/pmic.201400496)

Tudge SJ and Brede M (2015)
A tale of two theorems: Comment on "Universal scaling for the dilemma strength in evolutionary games" by Z. Wang et al.
Phys. Life Rev.14: 49-51. (doi:10.1016/j.plrev.2015.07.003)

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