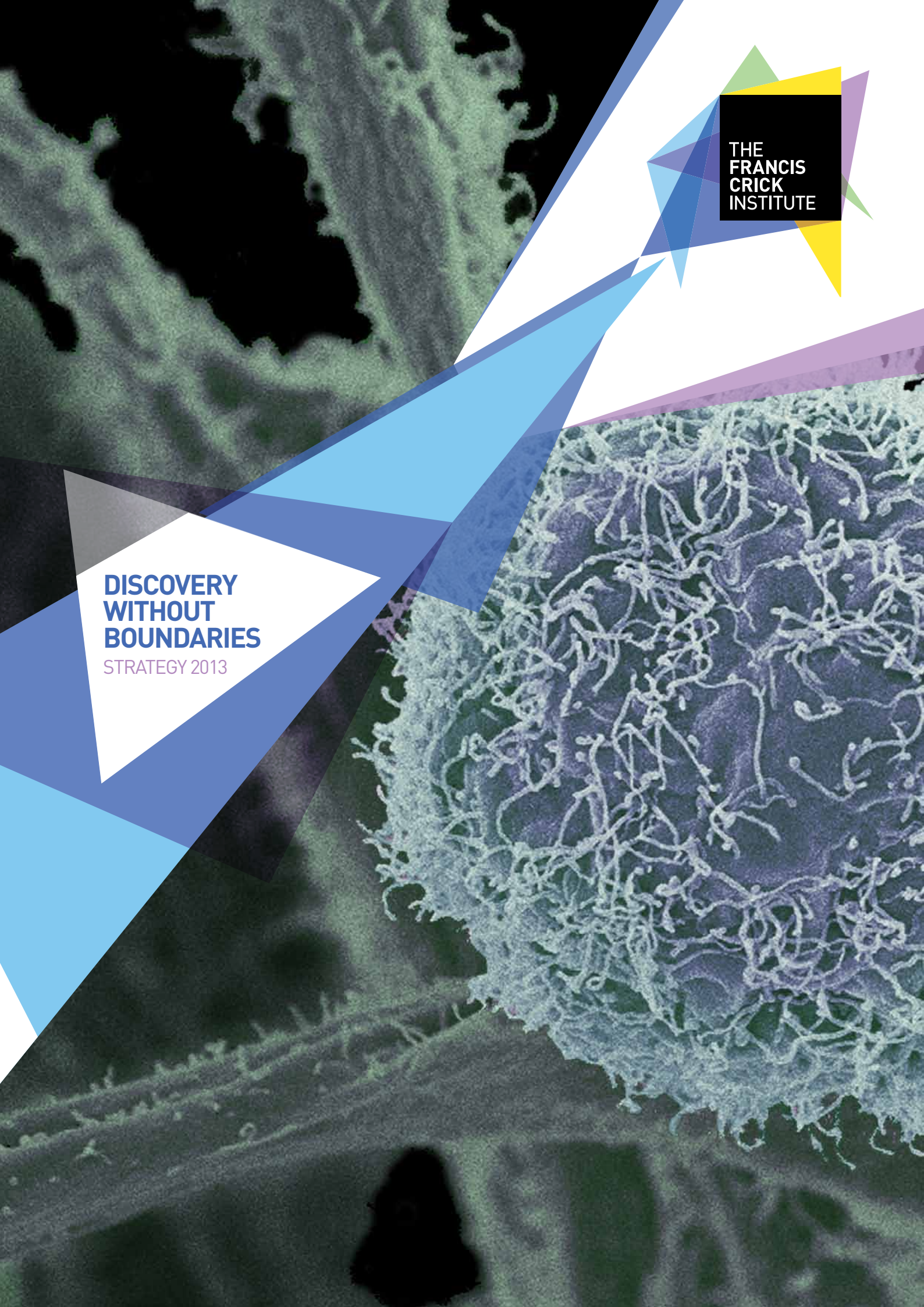

THE FRANCIS CRICK INSTITUTE

DISCOVERY WITHOUT BOUNDARIES

STRATEGY 2013

The title 'Discovery without boundaries' reflects the Crick's intention to maximise permeability across a variety of boundaries, both internal and external to the institute.

It epitomises the way we will operate to bring together the expertise of our six founders; integrate research and its translation into the clinical and commercial spheres; and foster interaction across a wide range of scientific disciplines and disease areas. It also captures the nature of the interactions the Crick will have with the outside world: building national and international research collaborations and opening our doors to the public.

Preparing sepharose beads for an immunoprecipitation, LRI.
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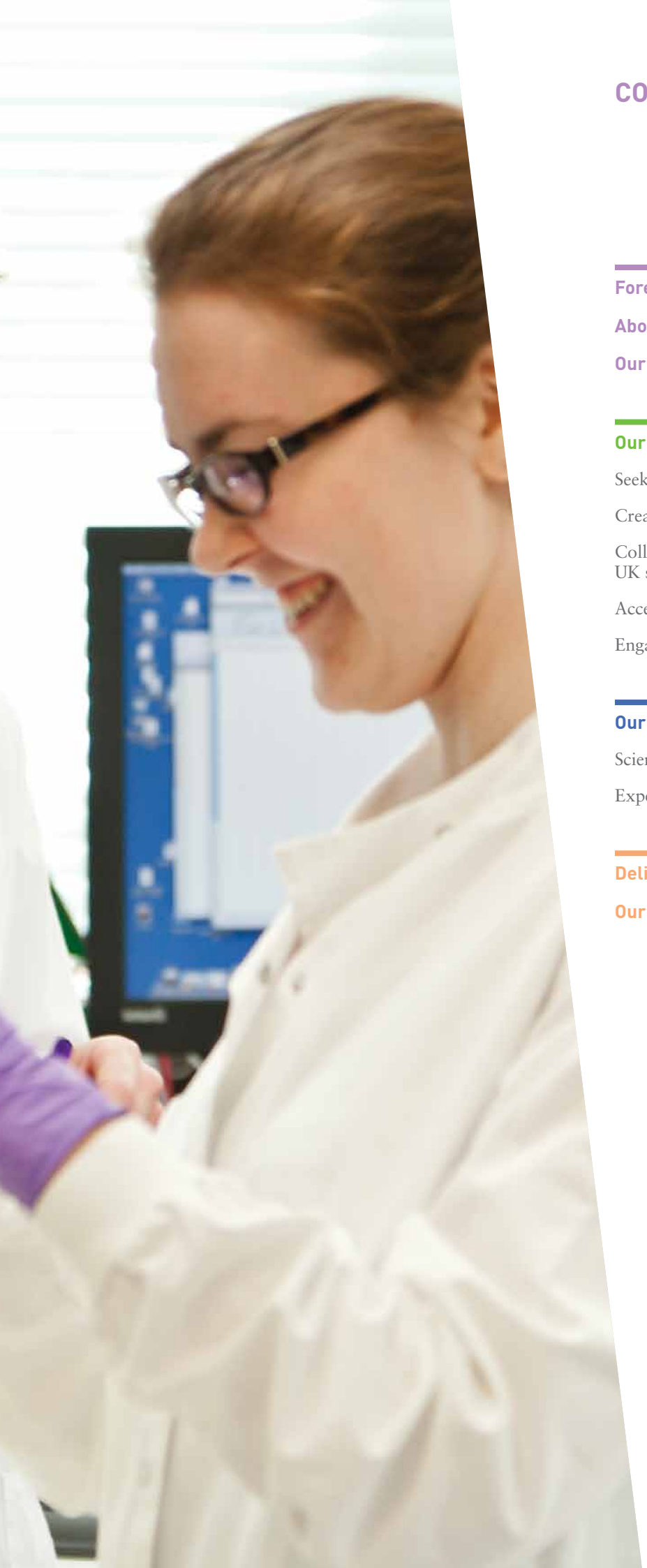

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FOREWORD

The Francis Crick Institute will open its doors in two years' time, but the idea has been a decade in the making. Our aim is to create a globally leading scientific research institute that can harness multi-disciplinary knowledge to answer fundamental questions of human biology. But why do we need a new institute, why now, and why in London?

First, because we face significant challenges to human health, both in the UK and globally. While life expectancy is increasing, cancer and circulatory disease still account for nearly two thirds of all deaths in the UK. Infectious diseases such as HIV/AIDS, malaria and tuberculosis continue to devastate many lives, particularly in poorer countries. Almost three million people die each year as a result of being overweight or obese, a problem shared by the developed and the developing world.

Second, because although the economic opportunities arising from medical research are considerable, there is increasing international competition to attract the best scientists, as well as the most innovative companies and the investment they bring. High quality discovery research is not easy, and the UK happens to be good at it. This gives us a head start, but we need to step up a gear if we are to continue to be competitive on the global stage. The UK biomedical research endeavour requires greater support and cohesiveness. This is the opportunity presented by the Crick.

So what ingredients do we need? First, we need the very best minds, from across the biological, clinical, and physical sciences. We need people who are prepared to work together, using broad and innovative approaches to investigate human biology and physiology. We need an atmosphere that maximises openness and permeability to ideas and talent from outside. We need closer contact with those who will develop and use the ideas and discoveries we create, whether in an industry or healthcare setting.

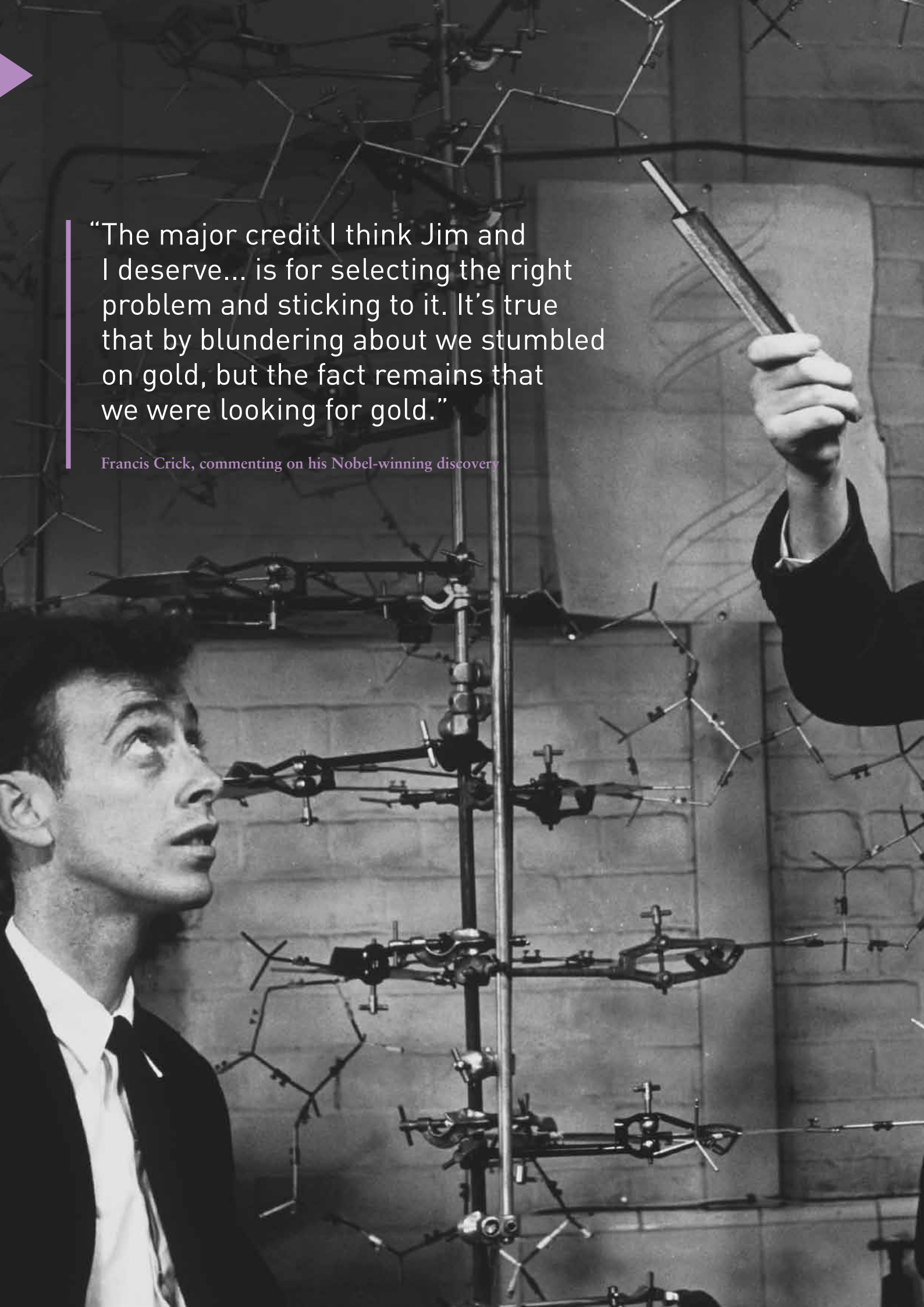
The Crick is a once in a generation opportunity to put these factors in place. We have two institutes that need rehousing - the National Institute for Medical Research (NIMR) and the London Research Institute of Cancer Research UK (LRI). We have commitment from the three major UK funders of medical research – the Medical Research Council, the Wellcome Trust and Cancer Research UK. We have a partnership with three of the world's leading universities – UCL (University College London), King's College London and Imperial College London – that will allow us to extract maximum value from the complementary strengths and scope of institute and university-based research. And we have a central London site which allows us to bring all those partners together, located near leading universities and hospitals, with access to genetically diverse populations, and close to public transport which enables easy contact with other biomedical research activities throughout the UK and internationally. London is also attractive for recruitment, particularly of the early career scientists who will make up the bulk of the institute's research staff.

When the Crick opens in late 2015, we will have created a new type of biomedical research institute.
Our uncompromising commitment to excellence, our emphasis on multi-disciplinary research, our focus on young and emerging talent, our novel ways of partnership working, and our plans to export our best people to other institutions, are some of the factors that will set the Crick apart. By working together, we have an unprecedented opportunity to place the UK at the forefront of global biomedical discovery and its translation into new treatments and technologies that benefit patients. This document explains how we intend to realise this exciting vision for UK, and global, biomedical science.

Sir Paul Nurse
Director

We have an unprecedented opportunity to place the UK at the forefront of global biomedical discovery and its translation into new treatments and technologies that benefit patients.

Sir Paul Nurse. ©BBC



"The major credit I think Jim and I deserve... is for selecting the right problem and sticking to it. It's true that by blundering about we stumbled on gold, but the fact remains that we were looking for gold."

Francis Crick, commenting on his Nobel-winning discovery

FRANCIS CRICK

Francis Crick (1916 - 2004) was one of Britain's great scientists. He is best known for his work with James Watson which led to the identification of the structure of DNA in 1953, drawing on the work of Maurice Wilkins, Rosalind Franklin and others. This discovery proved to be of enormous importance to biomedical research — and to life and health — and earned Crick, Watson and Wilkins the Nobel Prize in Physiology or Medicine in 1962.

Crick began his scientific career in physics, obtaining a BSc from University College London in 1937. During World War Two he worked as a scientist for the Admiralty Research Laboratory, working on the design of magnetic and acoustic mines.

In 1947 Crick made the transition from physics into biology, which he described as "almost as if one had to be born again." His early studies at Cambridge were supported by a studentship from the Medical Research Council (MRC). In 1949 he joined the MRC Unit headed by Max Perutz, which subsequently became the MRC Laboratory of Molecular Biology. During this period he worked on the X-ray crystallography of proteins, obtaining his PhD in 1954.

A critical influence in Crick's career was his friendship, beginning in 1951, with James Watson, then a young man of 23. They shared an interest in the fundamental question of how genetic information could be stored in molecular form, leading in 1953 to the proposal of the double-helical structure for DNA. Crick then concentrated on the biological implications of the structure of the DNA molecule, developing further insights into the genetic code – including the so called 'central dogma' explaining the flow of information from DNA to RNA to protein. In subsequent years he expanded his interests to focus on how the brain works and the nature of consciousness.

Francis Crick was noted for his intelligence, openness to new ideas, and his collaborations with scientists working in different fields of expertise. The Francis Crick Institute will embrace these qualities as it strives to achieve excellence in biomedical research.

Photo credit: The discoverers of the structure of DNA. James Watson (b. 1928) and Francis Crick (1916-2004), with their model of part of a DNA molecule in 1953. Crick and Watson met at the Cavendish Laboratory, Cambridge, in 1951. Their work on the structure of DNA was performed with a knowledge of Chargaff's ratios of the bases in DNA and some access to the X-ray crystallography of Maurice Wilkins and Rosalind Franklin at King's College London. Combining all of this work led to the deduction that DNA exists as a double helix. Crick, Watson and Wilkins shared the 1962 Nobel Prize for Physiology or Medicine, Franklin having died of cancer in 1958. Photographed in the Cavendish Laboratory, University of Cambridge, UK, in May 1953.

A. BARRINGTON BROWN/SCIENCE PHOTO LIBRARY

ABOUT THIS DOCUMENT

This is a strategy for a new institute, which has yet to open. The document sets out the main principles that will guide the development of the Crick and the high level strategic objectives we will pursue. It emphasises the importance of getting the culture of the institute right, as this will set our direction for decades to come.

The Crick under construction. © Wellcome Images

At the heart of the Crick's philosophy is a commitment to the highest quality science. We believe that the necessary quality can only be delivered through a focus on the best and most imaginative scientists, which in turn requires a broad and flexible approach to our scientific programme. As we move closer to opening, the broad programmatic details contained in this document will be updated to reflect the strengths of scientists moving to the Crick, the latest research strategies of our founders, the developing engagement with our university founders, promising new areas arising from our horizon scanning activities and the mechanisms needed to facilitate effective translation of Crick science.

This document is not an operational plan, and does not provide details of finances, staffing, or stakeholder relationships. Rather, it provides a strategic framework which will guide subsequent operational plans. Detailed financial and implementation plans will be developed during the period leading up to the opening of the institute. These will reflect a number of issues that require further discussion with our six founders, including:

- the agreed financial contributions of our founders, and our access to other funding sources;
- the operational budget;
- administrative details of collaborations with our university founders, and others;
- transitional arrangements, including the transfer of staff from NIMR and LRI; and
- the mechanisms of scientific review at the Crick.

The operational plan will include appropriate timelines and checks to monitor progress.

Throughout this document the term 'founders' is used to refer to the Crick's six founding partners: the Medical Research Council; Cancer Research UK; the Wellcome Trust; UCL (University College London); Imperial College London; and King's College London. 'University founders' is used to refer to the latter three organisations.

We believe that the necessary quality can only be delivered through a focus on the best and most imaginative scientists, which in turn requires a broad and flexible approach to our scientific programme.

Performing mRNA extraction from cells,
© The Francis Crick Institute

OUR VISION

Our vision is to discover the biology underlying human health, improving the treatment, diagnosis and prevention of human disease and generating economic opportunities for the UK.

To advance this vision, we will create a distinctive research institute which will act as a fulcrum of biomedical research excellence across London and the UK, driving up quality, concentrating effort and catalysing new interactions between partners and across research disciplines.

The proportion of national biomedical research activity contained within the Crick will be small, but our aim is to have a much wider influence on research quality and research coordination. By maximising interaction and synergy between the Crick, its partners, and other collaborators, the new institute will support the biomedical research endeavour throughout the UK. It will help to leverage the UK's strengths in biomedical research to create health and economic benefits.

We are:

Bold

We support ground-breaking discovery science, pursue excellence on the international stage, and are not afraid to do things differently.

Imaginative

We take a long-term view, encourage creative approaches, and explore connections between disciplines.

Open

We are permeable to outside talent and ideas and committed to transparent science for the public good that meets the highest ethical, animal welfare and biosecurity standards.

Dynamic

We continually develop and refresh our science, are open to pursuing new opportunities, and adaptable enough to change course quickly.

Collegial

We mentor and support our staff, forge scientific connections in the UK and internationally, and work with our founders and the public to support the development of the UK science and innovation ecosystem.

Staff at King's College Hospital.
©King's Health Partners

OUR STRATEGIC PRIORITIES

OUR STRATEGIC PRIORITIES

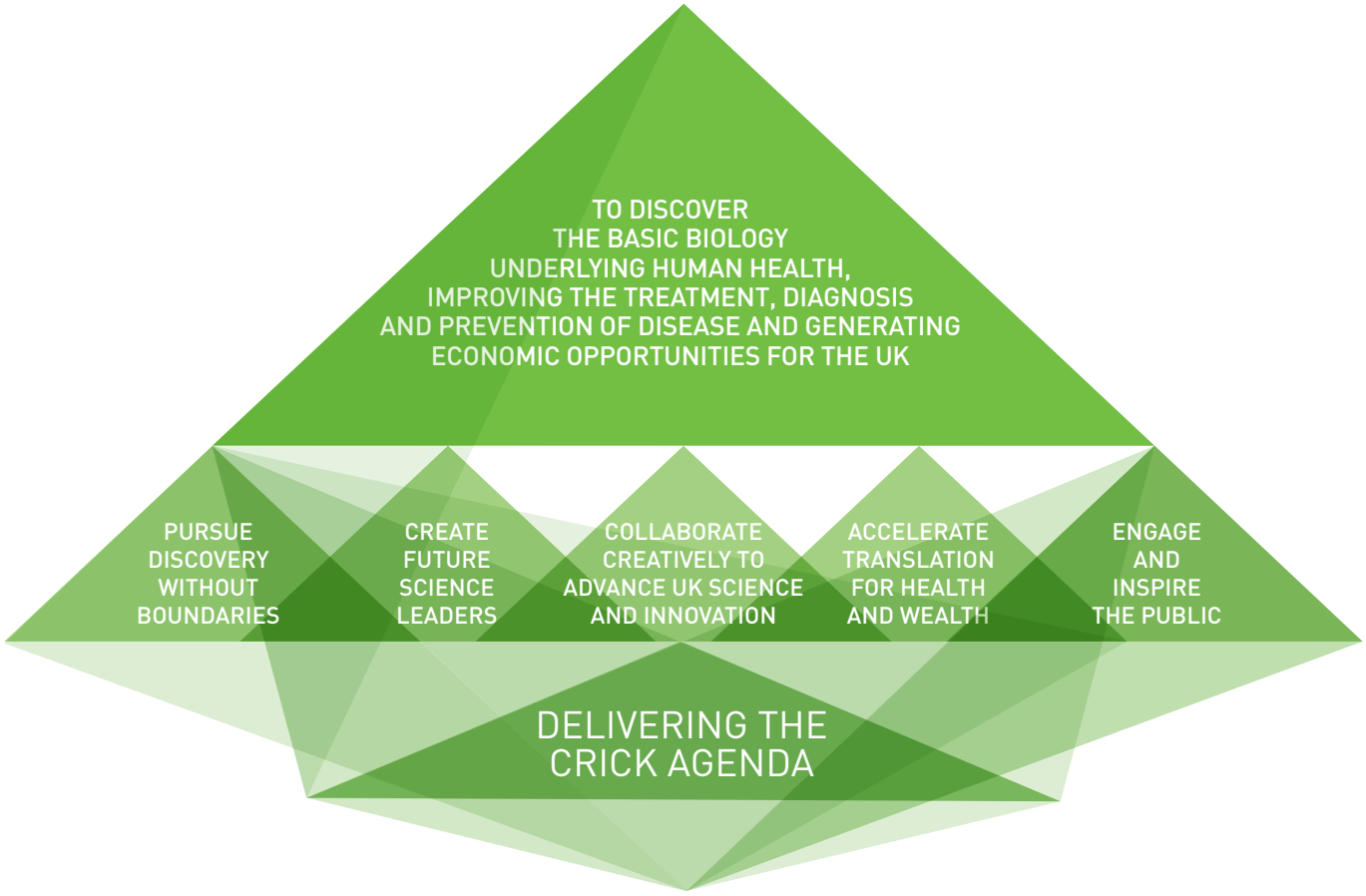
Science and innovation generate the skills, knowledge and technology needed to improve healthcare and to drive the economy. The UK's research performance is world-class and that quality must be maintained. However, we need to improve our ability to translate and leverage scientific discoveries to create a healthier and more prosperous society.

To achieve these objectives, the UK's biomedical research base must be of the highest quality, become more networked and collaborative, and set higher benchmarks for scientific training. This is why the Crick founders are joining forces to create a single world-class centre for multi-disciplinary research into the biological basis of human health. The Crick is based in London, but our vision is UK-wide, and relevant world-wide. Critical to our success will be our ability to deliver knowledge, skilled people, health improvements, and economic opportunities for the benefit of the UK as a whole.

Our five strategic priorities summarise our role and commitment to maximising the potential of biomedical research and innovation across the UK:

1. *Pursue discovery without boundaries*
2. *Create future science leaders*
3. *Collaborate creatively to advance UK science and innovation*
4. *Accelerate translation for health and wealth*
5. *Engage and inspire the public*

We are scheduled to open our doors in late 2015. An important priority in the intervening years will be developing our culture and organisation and establishing the internal capability we need to deliver the Crick agenda.



Critical to our success will be our ability to deliver knowledge, skilled people, health improvements, and economic opportunities for the benefit of the UK as a whole.

Discussing phenotyping strategies in the Immunobiology Laboratory, LRI.
© The Francis Crick Institute

STRATEGIC PRIORITY 1: PURSUE DISCOVERY WITHOUT BOUNDARIES

The Crick will be one of the world's largest dedicated biomedical research centres, bringing together over 1200 researchers from a range of disciplines to discover the basic biology underlying human health and disease. High quality science from the two parent institutes NIMR and LRI will provide an underpinning foundation for the Crick research portfolio. We will build substantially on this, identifying and nurturing new research opportunities and developing strong synergies and novel scientific interactions between our research groups at the Crick, the three university founders, and our other collaborators across the UK. Our intention is to develop a distinctive approach to biomedical research that fosters excellence, breaks down barriers between disciplines, works across institutions and integrates knowledge gained from studies at different levels: molecular, cellular, organ, whole organism and population.

The Crick will:

Support creative and ambitious research that addresses important scientific questions

We will use innovative and pioneering approaches to investigate human biology, using both human material and a variety of model organisms to enhance our understanding of the relevant biological processes. Our research will address questions relevant to a wide range of human illnesses, including cancer, cardiovascular disease, infectious disease, autoimmunity and disorders of brain and behaviour. We will seek to understand the processes that support an organism's healthy development and growth, as well as its eventual ageing and decline.

Our status as a primarily core-funded institute will enable the Crick to both take a long-term approach to important research problems, and to respond rapidly to new opportunities. We will support our research groups to pursue challenging and creative research projects, working in an interactive and collaborative manner. Our dynamic career structure, focus on quality and emphasis on recruiting researchers with outstanding potential will enable continuous renewal and reinvention of an imaginative research portfolio.

Emphasise multi- and inter-disciplinary approaches to biomedicine

The Crick will be distinctive for the high quality of our science, and for our willingness to re-examine the way scientific research is conducted. Biomedicine is becoming progressively more dependent on other scientific disciplines, including physics, chemistry, engineering and computational sciences. To succeed in this changing environment, we must develop ways of working that are receptive to new techniques and approaches and unconstrained by traditional disciplinary boundaries. For this reason, we will not arrange our internal structure along disciplinary lines. Instead, we will encourage the bottom-up development of 'interest groups' that bring together researchers from across the organisation to share insights and plan activities in areas of common scientific interest. The structure of the building is also designed to encourage mixing. Scientists will be drawn together at interaction and collaboration facilities located at the centre of each floor and at the institute-wide facilities on the ground floor.

The Crick's size will give us the ability to bring together groups working in a wide range of disciplines and using different experimental approaches. The integration of the three university founders UCL, Imperial and King's will increase the capacity for inter-disciplinary engagement by a further order of magnitude, as they will bring to the Crick a huge volume and range of expertise and facilities, in particular from the physical, engineering and clinical sciences. We will work with the university founders to identify and recruit exceptional physical scientists and engineers who can help develop a culture of multi-disciplinarity and technology development at the Crick. Increased interactions between biological and physical sciences will pay dividends to both sides, introducing new data, methodologies, concepts and perspectives and stimulating the development of novel approaches to problems.

Fostering multi- and inter-disciplinary thinking will be a key focus of our research and training programmes, and all the activities we conduct with our UK partners. We will place emphasis on improving the ability of junior researchers to communicate and interact effectively with colleagues from other disciplines.

Break down barriers between basic and clinical research

The outstanding discovery science conducted at the Crick will have the potential to drive important improvements in human health, both in the UK and globally. To realise these health benefits, we need to create an environment where basic and clinical scientists can work together closely and effectively. This means working with each other and with the new Academic Health Science Centres and networks, in particular those in London led by the three university founders.

We are working with our university founders to recruit a number of outstanding senior clinical scientists. These individuals will have their laboratory base at the Crick and will act as a catalyst to establish the desired culture. They will act as mentors for junior researchers, champion clinical research and translation across the organisation, forge close links with our university founders and their academic health science centres and help us to attract excellent clinical investigators at all career stages.

The Crick will not have on-site facilities for patient-based research, but will link with the clinical and regulatory expertise and networks available through the three university founders, their Academic Health Science Centres (AHSCs) and NIHR Comprehensive Biomedical Research Centres (BRCs). This close working relationship will allow novel scientific hypotheses - such as proposed mechanisms of disease, new therapies, potential predictors of disease progression and new prevention strategies - to be clinically investigated and tested. It will foster the development of experimental medicine, a key element of translational research.

National strategies to promote translational research and increase the uptake of research within the NHS have seen a concerted focus on promoting closer working between clinical and non-clinical researchers. Our training programmes will build on the progress that has already been made, with an emphasis on building mutual understanding and respect amongst researchers from clinical and basic biomedical backgrounds. Participants will be encouraged to explore how research discoveries can be applied to clinical problems, and how clinical practice can provide a rich source of questions to inform laboratory investigation. The co-location of basic and clinical researchers and the two-way movement between the Crick and the partner AHSCs, particularly at the training stage, will build the institutional bridges and foster the personal links that will drive future collaboration. Partnership working with academic health science centres will ensure continuing support of clinical academic trainees after they leave the Crick.

Develop world-class research infrastructure and facilities

World-class science requires access to state-of-the-art research infrastructure. Excellent core technology facilities, both within the Crick and our three university founders, will provide a central resource to facilitate research across the institute. Those within the Crick will operate as self-standing units, coordinated by user committees. We will formally review our core facilities and our access to external facilities on a regular basis, to ensure they remain cutting-edge, cost-effective and relevant.

Ensure that our experimental data are transparent, reproducible and openly available

Increases in the volume and complexity of the data generated through biomedical research, and the availability of new experimental tools and techniques, are posing new challenges for data reproducibility and interpretation. We want the Crick to be a leader when it comes to producing high quality, reproducible experimental data. We will support this by developing high research standards and a strong culture of internal peer review, which enables research findings to be internally critiqued and validated.

We are also committed to making data arising from our research freely accessible to the scientific community. This will both enable external validation and analysis of our data, and maximise its value as a resource for national and global biomedical research. We will work closely with our founders and collaborators to explore new ways of managing and using large volumes of data. Where our research draws on personal information from patients, we will adopt a best practice approach that reflects the importance of confidentiality and data security.

Maintain the highest standards for animal welfare and biosecurity

Research involving animals has played a central role in modern medicine, underpinning our current understanding of how the body functions in health and disease and enabling the development of important new treatments. The Crick will place a particular focus on human biology, and is committed to exploring alternatives to research using animals. In many areas of biomedical research work with animals remains essential, and we will ensure that animal welfare is always given the highest priority. We support public dialogue on the use of animals in research, and will openly explain the aims and methods of our research.

The Crick's research programmes will include work on pathogens and infectious agents. This research will advance understanding of the biological mechanisms that enable these pathogens to cause illness, and ultimately contribute to the development of new treatment strategies. We will maintain robust biosecurity procedures to ensure the best protection of our staff, our visitors and our neighbours.

Example of High Performance Computing capacity using UCL's Legion Cluster.
© UCL Creative Media Services

CREATING THE NEW INSTITUTE

The Crick's striking new building, designed by architects HOK with PLP Architecture, will provide a state-of-the-art research facility that supports the strategic priorities outlined in this document.

Design

Architecturally, the institute relates both to its large civic neighbours to its south - St Pancras and the British Library - and the smaller scale residential buildings of Somers Town to the north and west. The design distinguishes the laboratories, found in the main body of the institute, from the elegant vaulted roof which gently curves east to west to bring the scale of the building down at its edges. The four laboratory wings are lit by a long atrium running east-west crossed by a north-south atrium. These will act as grand windows into the building and offer glimpses of the social and break-out spaces within. The atria are very tall, allowing light to flood into the heart of the institute and drawing visitors into the main circulation and social spaces.

The building is designed to be highly sustainable and will reduce and recycle as much energy as possible. A Combined Heat and Power system will produce electricity on site, supplemented by photovoltaic cells to generate solar power. The building materials have been selected to minimise environmental impact and are from recycled sources wherever possible. In the course of the construction project over 400,000 tonnes of soil was removed – enough to fill 72 Olympic swimming pools. All of this excavated soil was reused in construction or environmental projects, including helping to create a bird and wildlife sanctuary on the Essex marshes.

Encouraging interaction

Within the building, the laboratories themselves are arranged over four floors. A typical floor is divided into four blocks or neighbourhoods which will bring together staff working in different fields.

The design of the laboratory areas will break down barriers between different groups and scientists. The floors are as open as possible both physically and visually so that people will be in close contact with their colleagues. Where there are partitions between laboratory spaces, they are transparent, if the science allows, to maintain the high levels of natural light throughout the building. To encourage people in different disciplines to work together, there are break-out spaces which allow for chance meetings on each floor. Shared facilities are strategically located to encourage interactions. The ground floor will play a big role in this process with its seminar and meeting rooms, lecture theatres and dining facilities.

Engaging the public

The architecture celebrates the public programme offered by the Crick. By setting the public entrance at ground level, it will be welcoming and accessible. The building will be open to the public for lectures and exhibitions, with a teaching laboratory for school children. Social space - the meeting and dining areas at ground floor level - give the building a lively feel for passers-by on Brill Place.

Ground floor reception area and auditorium.
© HOK and Glowfrog Studios

Young people at the Crick and LRI's 'Ask a Nobel Scientist' event.
© Wellcome Images

View from St Pancras International.
© Justin Piperger Photography/Wadsworth3

STRATEGIC PRIORITY 2: CREATE FUTURE SCIENCE LEADERS

The Crick will develop an approach to biomedical scientific training and recruitment that reflects our commitment to research excellence, dynamism and multi-disciplinary activity. Our career structure will be unusual, with the majority of group leaders remaining at the institute for no more than 12 years before being supported to find scientific leadership positions elsewhere, with a strong emphasis on UK institutions. This process will help the Crick to fulfil its national role by expanding the talent pool for biomedical science across the UK. This dynamic career structure and the associated staff turnover will allow the introduction of fresh knowledge and ideas to drive the development and renewal of our scientific programmes.

The Crick will:

Pursue a 'best scientific athlete' approach to group leader recruitment, ensuring that the highest quality scientists are identified and appointed

Recruitment to Crick group leader positions will be international. Our scientific reputation, dynamic multi-disciplinary culture and central London location will give us the ability to recruit outstanding scientists from around the world. The Crick culture will particularly appeal to individuals who are gregarious and enjoy interacting with colleagues with diverse interests.

The 'best athlete' approach, which emphasises the primacy of excellent individuals, is used internationally by research funders highly focused on quality. The idea is to identify broad research programme umbrellas and then conduct an open search covering these areas. Appointments are made based on a joint consideration of the quality of the candidate and his or her research programme. The approach allows the institute to fish in a larger pool of candidates at any point in time, driving up quality. Over time open searching generally results in successful recruitment across a broad range of research areas.

The size of the Crick and the relatively rapid turnover of group leaders will allow us to pursue the best athlete approach very effectively, driving up the quality of recruitment. If gaps in the portfolio appear, or an exciting new area of science emerges, the open approach will be complemented by more focused searches.

Develop a dynamic career structure that supports the development of world-class researchers

Supporting the development of excellent scientists, from established group leaders to those embarking on their research careers, is central to the Crick's mission and an important aspect of our role as a national institute. Our approach to career development will balance the need for continuity of research leadership with a regular flow of new talent which can challenge existing ideas and practices and drive the continual refreshment and evolution of the Crick's research programmes. Most of our group leaders will be scientists in early or mid-career. This is typically a highly creative and productive period, but one where the scientist can be inexperienced and vulnerable and so will profit from the supportive culture of the Crick.

Our group leaders will be well resourced, with a mix of core support and response funding. They will run research groups of medium size - in general 6-12 people. This will promote a culture of collaborative research by group leaders and ensure effective use of resources. The restricted size of our research groups will also encourage group leaders with the desire to establish larger research groups to move and grow in other institutions, supporting our role in building the UK science base.

The majority of our group leaders will be enrolled in the Investigator programme, which will have two types of appointment:

- The Crick Assistant/Associate Investigator programme will support talented early career researchers to reach their full potential by providing stable funding, access to excellent facilities, career mentoring by experienced senior scientists, and the opportunity to interact with distinguished colleagues. These junior researchers will acquire experience in teaching and university-based research through our three university founders, broadening their professional experience and career development and facilitating a possible move to the university sector when they leave the Crick. The 12 year Assistant/Associate Investigator appointments will allow ambitious long-term projects to be undertaken. Quality reviews will take place at six years to approve promotion from Assistant to Associate, and at 12 years when the Investigator leaves the Crick. Our long-term aim is for around two thirds of group leaders to be Assistant/Associate Investigators.

- Crick Senior Investigators will be distinguished scientists and clinician scientists who are international leaders in their field. They will be appointed on an open term basis, and in the longer term will make up about one third of the group leaders. They will be recruited in open international competition and will conduct ambitious long-term research programmes of strategic importance to the Crick and to UK science. Senior Investigators will be expected to contribute to all aspects of the institute's scientific operations, including mentoring their colleagues in the Assistant/Associate Investigator programme. They will be subject to a regular, rigorous and independent review process.

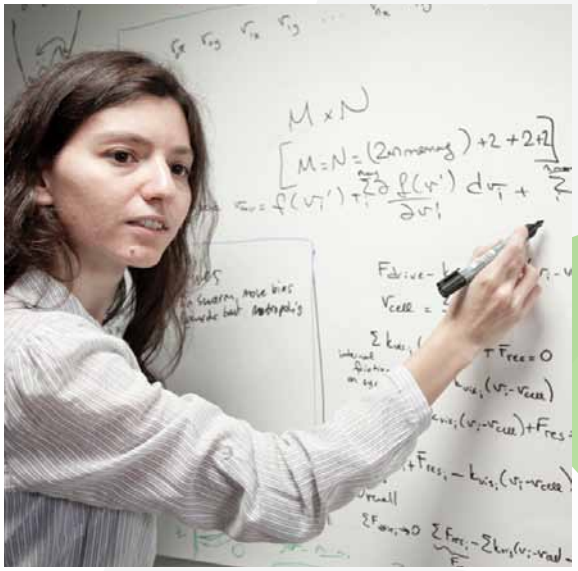
Associate Investigators will be expected to leave the Crick at the end of their 12 year appointment period. Our senior faculty will play an important role in preparing departing Investigators for their next career move and helping them to establish relationships with potential host institutions, particularly in the UK.

Support flexible research careers

While PhD programmes in the life sciences tend to attract roughly equal numbers of men and women, women remain under-represented at more senior research career levels. Women choose to leave academic research for a range of reasons, and many go on to build successful careers in other fields. However, research employers need to address concerns that research careers are less flexible or family-friendly, and that the research environment and culture is not sufficiently supportive. We want the Crick to be seen as a leader when it comes to supporting women in science, and flexible careers more generally, for example by:

- providing for part-time and shared working within our Investigator programme;
- ensuring that our recruitment and assessment processes do not discriminate against people who have taken career breaks;
- providing a supportive, mentoring working environment; and
- helping our employees to balance their work and family commitments.

The majority of our students and scientific staff will eventually leave the Crick to move to another institution. We will take advantage of our links with our London and UK partners to help people to plan their next move in a way that makes sense from both a career development and personal standpoint.



Top: Purifying DNA plasmids from bacteria. © The Francis Crick Institute
Bottom: PhD student at work. © The Francis Crick Institute

Top: Clinical researchers based at University College London Hospitals NHS Foundation Trust. ©UCL Creative Media Services

Bottom: Discussion at lab meeting. © The Francis Crick Institute

Create a multi-disciplinary training programme for junior researchers at PhD and postdoctoral level - including opportunities for students from disciplines outside biology

The Crick's PhD and postdoctoral training programmes will reflect the multi-disciplinary focus of the Crick, with opportunities for physical science students wishing to develop their interest in biology. We will also aim to produce clinically-literate basic scientists, so that trainees and more senior staff have a good understanding of disease and clinical research and the challenges facing health care systems throughout the world.

Our internationally competitive PhD programme is being developed in close collaboration with our university founders, who have very extensive collective experience in delivery and quality control of research training, and will award the degrees. The programme will be designed to appeal to students from diverse backgrounds (non-clinical and clinical as well as the physical sciences), qualifications (undergraduate vs. masters level degrees), and research experience. Students will engage in basic, translational, applied and clinical research in a multidisciplinary setting, taking full advantage of the wide range of expertise, technology platforms and facilities available through the university founders.

Some of our PhD graduates will choose to pursue careers in areas outside biomedical research, contributing their knowledge and skills to the broader economy. We see this as a valuable outcome of Crick PhD training and will support it by including career advice and mentoring at the beginning of the final year of our PhD programme. We will work with our partners to develop opportunities for our students to undertake internships and placements during their final year, for example in scientific publishing; science policy and communications; teaching; or intellectual property management.

At the postdoctoral level, we aim to equip postdoctoral scientists for independent research positions or for other scientific careers. Our postdoctoral fellowship programme will be flexible in duration, with the option of a longer development period to facilitate progression to research independence for those committed to an academic career. We will provide support and advice for postdoctoral trainees who wish to explore career options outside research. We will also consider developing a programme of independent research fellowships to operate in parallel with our postdoctoral programme. Such a programme would support early postdoctoral scientists who wish to pursue their own autonomous research projects without the responsibility of running a research group.

Act as a national centre for integrated scientific training of academic clinicians

As part of our national role we will provide an integrated training programme for academic clinical scientists from PhD to group leader level. Our human biology and translational research initiatives, excellent research training environment, and our close links with London university teaching hospitals will make this programme an especially attractive option for clinicians seeking an academic medical career. We will place particular emphasis on the early post-doctoral stage, where a major drop out in clinical careers currently occurs. The Crick and its university founders will explore novel ways of linking clinical posts with Crick appointments to help reduce this attrition.

Clinical PhD candidates will be recruited by national competition amongst the best qualified and brightest potential clinical trainees. An important additional cadre of trainees will be identified through engagement in MB PhD programmes at our three university founders. We will encourage the current practice of making these programmes available to medical students nationally. Follow-up mentoring and continuing engagement will be essential in enabling graduates of the programme to build on their scientific training while they undertake clinical training.

At the postdoctoral level, Crick Clinical Lectureships will fund clinically-qualified applicants for 12 months' research to develop a research proposal suitable for intermediate fellowships from major research funders.

Support undergraduate bioscience training

We will host a summer student programme open to students from across the UK. In partnership with universities we will also seek to provide laboratory placements for longer-term undergraduate project work and 'sandwich' courses. Supervision of such placements will be an important aspect of postdoctoral training.

Leverage our excellent scientific facilities to provide training opportunities

The Crick will develop cutting-edge technology platforms, workshops and scientific facilities, run by well-trained and experienced research support staff. To provide more specialised or extended facilities, access to research core platforms and workshops in our partner institutions will also be negotiated (with reciprocal access to Crick facilities). Given the turnover envisaged for group leaders at the Crick, a cadre of capable and experienced and research support staff will provide important continuity of technical expertise.

The breadth of science at the Crick will provide an excellent training ground for research support staff to develop their skills, whether based in a laboratory or a technology platform facility. The Crick will implement a continuous training programme designed to enable them to develop an adaptable and broad skill set. Special emphasis will be given to recruiting and training junior staff who will subsequently be attractive recruits for other UK biomedical research institutions.

We will also welcome visitors from other institutions who wish to learn about the design and operation of scientific core facilities. We will offer high level practical research courses to introduce new techniques and methods to scientists from around the UK, taught by faculty from the Crick and elsewhere.

STRATEGIC PRIORITY 3: COLLABORATE CREATIVELY TO ADVANCE UK SCIENCE AND INNOVATION

The Crick is a landmark partnership between the UK's three largest funders of biomedical research: the Medical Research Council, Cancer Research UK and the Wellcome Trust, and three of its leading universities: UCL, Imperial College and King's College London. This represents an unprecedented joining of forces to tackle major scientific problems and generate solutions to the emerging health challenges of the 21st century.

The partnership occurs in the context of a strong national commitment to life sciences research and innovation, reflected in the government's Strategy for UK Life Sciences and associated plans to boost innovation uptake within the National Health Service. The Crick will bring together the very significant biomedical and physical science strengths that exist within London, while fostering interaction with other centres of excellence across the UK.

We will actively develop and promote novel forms of partnership, both with our founders and the broader UK scientific community. By creating an integrated biomedical research effort that brings together the best minds from research, academia and industry, we will maximise opportunities in all the areas identified in this document: opportunities for scientific discovery, for world-class training, for translation to transform health and the economy, and for engagement with audiences outside science.

The Crick will:

Support novel and creative ways of working with our founders, so that partnership working permeates everything we do

Our six founders have each made a substantial investment in the Crick. We have a reciprocal obligation to develop ways of working together that add value to the mission of each partner, and make the whole more than the sum of its parts. Our willingness to re-examine the way in which scientific research is conducted will be complemented by the development of novel and creative ways of working with our founders.

We will promote and embed partnership working throughout the Crick, wherever it can augment and enhance our core scientific mission. In this way we will create a distinctive culture that takes advantage of the transformational opportunities offered by the totality of the biomedical and physical sciences in London, as well as experimental medicine and translational clinical science. Partnership working will ensure that the translational ambition of the three Academic Health Sciences Centres associated with our university founders will influence the scientific culture and vision of the Crick.

The increasing dependence of biomedicine on other scientific disciplines compels new structures to support new ways of working. Our approach to collaborative configurations of 'interest groups' internally will be combined with the bottom-up development of broader partnerships, not just with our founders but across the UK. We will recruit clinician scientists and develop mechanisms that encourage our biomedical scientists to partner with clinicians and health professionals throughout London's Academic Health Sciences Networks. The structure of our decision-making and our open partnership with our founders is designed to encourage such flexible and creative approaches.

Examining fruit flies for genetic changes.
© The Francis Crick Institute

Group discussions at the Crick Postdoc retreat.
© The Francis Crick Institute

Work with our university founders to explore clinical, translational and multi-disciplinary research opportunities

A primary distinctive attribute of the Crick is that it brings together two world-class research institutes with three of the world's leading universities. While the Crick is an independent research institute pursuing its own research vision, partnerships with the three universities and their associated research hospitals will be critical to achieving this vision.

Imperial, King's and UCL bring a wealth of locally accessible scientific expertise in areas complementary to the scientific strategy of the Crick. One of the crucial contributions that the university founders will bring to the Crick will be their expertise in clinical research and in the physical sciences including chemistry, physics, engineering, nanotechnology, mathematics and computational sciences – areas where it would be difficult to achieve a critical mass within the Crick itself. Also important will be the universities' high quality infrastructure, which includes the London Centre for Nanotechnology, the pan-London molecular imaging facility Imanova and three of the UK's five Academic Health Sciences Centres.

These resources and expertise will help realise the Crick's commitment to promote both multi-disciplinarity and clinical translation. The partnership between the Crick and the universities will enable us to deliver research of breadth and impact beyond the realistic capability of a stand-alone institute, even one the size of the Crick. We are exploring potential collaborations across a number of focus areas including: physical, mathematical, computational sciences and engineering; stem cells and regenerative medicine; genetic epidemiology; clinical translation; imaging; neuroscience and cognition; chemical biology; and high performance computing.

Our goal is to create highly permeable boundaries that facilitate seamless movement of researchers between the Crick and its three university founders. For this reason, university appointments at the Crick will be flexible and tailored to the individual appointee. They will include a mix of secondments, longer-term joint appointments, and 'satellite groups' - a mechanism to enable university-based research groups to establish a small outpost at the Crick while retaining strong connections with their home department. We will also encourage reciprocal movement, with secondments of Crick researchers to the university founders or Crick satellites based at one of the university founders.

These flexible arrangements will enable us to establish close links with a variety of biological and non-biological departments within the three university founders. This will:

- facilitate multi-disciplinary and inter-institutional activity, for example by allowing appointees based in non-biological university departments to develop substantial biological interests through a base at the Crick;
- enable human subjects and patient-based research collaborations, for example through satellite groups of non-clinical Crick researchers based at one of the universities; and
- improve our ability to recruit excellent clinical scientists, by giving them flexibility to combine laboratory-based research at the Crick with patient-based research at their host university's clinical facilities.

> "The UK has a proud record of scientific achievement built on the work of great institutions like those involved in The Francis Crick Institute... The institute will maintain our country's leading position in biomedical research and help translate the findings into benefits for patients and the economy."
>
> *The Rt Hon David Willetts MP, Minister for Universities and Science*

Refresh the national research workforce by facilitating the dispersal of outstanding mid-career talent throughout the UK

The Crick's career progression route (detailed under Strategic Priority 2) will see the majority of group leaders depart from the institute towards the end of a 12 year appointment. Departing Investigators will receive a review prior to their exit, which will allow the Crick, working with its funders, to provide support to facilitate the individual's transfer to a new institution in the UK. As departing Investigators are recruited by other biomedical research centres throughout the country, this will create a network of outstanding scientists, with opportunities for continued interaction with each other and with the Crick for the rest of their careers. These personal links will in turn strengthen collaboration and networking at the institutional level.

Facilitate technology innovation and development

Progress in biomedical research requires the development of new technological innovations and solutions. The Crick is committed both to using cutting-edge technology and supporting its development. New technologies can be further developed by drawing on the comprehensive facilities and expertise available through our university founders. We will support external innovations, and the development of the UK's high-tech sector, by working with companies to promote the Crick and its university founders as linked sites for developing and testing new scientific equipment. This will ensure that our researchers have early access to the latest technologies as they develop.

High-throughput sequencing facility at the Wellcome Trust Sanger Institute. © Genome Research Limited.

Develop strategic partnerships that support and complement the Crick's scientific strengths

The three university founders are both an integral part of the Crick and an open conduit through to a range of scientific and other academic activity. We also envisage extensive collaborations with universities, medical schools and Medical Research Council, Cancer Research UK and Wellcome Trust research activities throughout the UK. For example, in cancer we expect to develop relationships with CR-UK Centres and Experimental Cancer Medicine Centres, drawing on their expertise with regard to specific cancer types, and their thematic translational approaches. We will seek a strategic alliance with the Wellcome Trust Sanger Institute, as its emphasis on the generation and application of genome-scale data sets and resources and large-scale biological screens will complement and support activities at the Crick. Links with respect to bioinformatic data will also be pursued with our neighbour the British Library.

Collaboration with other research institutions will be pursued on the basis of identified strategic opportunities, based around specific research or translational initiatives. Partnerships that allow the Crick to develop its national role in scientific training and career development will be a particular focus.

Act as a focal point for scientific networking and interactions across the UK and beyond

Our location at the King's Cross-St Pancras transport hub will make the Crick readily accessible to London and the rest of the UK, as well as continental Europe and the world. We will be able to act as a hub for UK biomedicine, facilitating access to and partnerships with the UK's outstanding universities, specialist academic hospitals and innovative life science firms. Our seminar and conference facilities will allow the Crick to become a focus for scientific discourse both within London and across the UK.

In addition to our formal links with our three university founders, we will develop a vibrant scientific exchange programme, welcoming scientists from other research centres, both academic and industrial, across the UK and internationally. This will be a flexible programme with the Crick hosting visiting scientists for variable periods, embedded in the laboratories of our Investigators or forming small satellite laboratories as appropriate. Crick scientists will also develop reciprocal relationships as visiting scientists at other institutions.

National and International Links

Local links

A selection of research and clinical centres within easy reach of The Crick

The Crick

Within 1 km

- UCL (University College London)
- Wellcome Trust
- Great Ormond Street Hospital
- Institute of Child Health
- Institute of Neurology
- London School of Hygiene and Tropical Medicine
- MRC Clinical Trials Unit
- National Hospital for Neurology and Neurosurgery
- University College London Hospitals

Within 2 km

- Cancer Research UK
- Medical Research Council
- King's College London
- St Bartholomew's Hospital (Barts)
- Barts and The London Medical School

Within 5 km

- Imperial College London
- Institute of Ophthalmology
- Moorfields Eye Hospital
- St Mary's Hospital
- Guy's and St Thomas' Hospital

STRATEGIC PRIORITY 4: ACCELERATE TRANSLATION FOR HEALTH AND WEALTH

The Crick will conduct discovery science, oriented towards solving human health challenges. Our translation and innovation strategy will focus on maximising the value that can be generated from this science, measured in terms of improvements in the lives of people in the UK and internationally, and in new economic opportunities. We will explore opportunities for new and improved therapies, diagnosis and prevention strategies. In many cases, this will be accompanied by opportunities to form new and grow existing businesses; boost the supply of highly skilled and mobile people across the UK economy; and develop other activities that reinforce the UK's position at the forefront of global innovation in the life sciences.

The Crick will:

Develop internal mechanisms to ensure that ideas and discoveries with potential for translation can be readily identified

Our focus on outstanding science will see significant numbers of potential applications emerging over time. These could be opportunities to improve the prevention, early detection and diagnosis of disease, as well as potential new medicines or treatment approaches. We will work with our partners to make sure promising opportunities for technology development and clinical translation can be identified at an early stage and effectively progressed. This means developing an environment that enables innovation, and effectively manages and drives the translation of research into clinical and commercial settings.

Identifying which scientific discoveries are ripe for translation requires tacit knowledge, experience and flair. As part of our core faculty, we will recruit senior champions with a successful track record in translational research. These champions will act as designated internal mentors and advocates for translation, helping to assess internal translation opportunities, and providing advice on how the Crick should progress them. They will be supported by internal technology transfer staff, working with the technology transfer groups of our founders, and by a translation advisory group with substantial and contemporary industrial experience.

An internal applied development fund will be available to support the further development of promising ideas, identified on a competitive basis. We will also encourage Crick researchers to apply for external translation or technology transfer funding. We will arrange visits and seminars from leaders in the venture capital community, and from business school academics specialising in biomedical and health-related research.

Make translatable science an integral and highly valued facet of our culture

We recognise that cultural barriers can inhibit successful translation. The Crick will blend different research cultures, encouraging mutual respect between basic and clinical researchers, and between scientists from academia and industry. We will encourage staff at all levels to take up opportunities within industry and clinical organisations, and will ensure this is valued as a career goal. Similarly, we will develop and promote reciprocal opportunities for people from industry and clinical organisations to spend time at the Crick. Promoting a flow of people across organisation boundaries will enrich our translation culture by facilitating the exchange of ideas and expertise and making translation role models visible to the Crick research community.

Researchers will be more likely to engage in translational activities if the right incentives are in place. The Crick career structure will allow innovators the freedom to flexibly engage in the commercial and clinical development of their research discoveries. We will help them to access the necessary support and mentoring, drawing on our university founders and external networks where the appropriate expertise is not available internally. We are aware of the long development times in many areas of translational research and the limitations these pose from an evaluation perspective. Taking account of this, we will monitor the progress and outcomes of translation and consider this in evaluating researchers' contributions, for individual advancement and reward, and for use in appraisal of the institute's accomplishments and success.

To stimulate translation-orientated thinking and enhance our translational culture, we will establish a centre-wide seminar series featuring talks on the technological, clinical and commercial development of research.

Partner with outside organisations to export innovative research knowledge and inventions, using a flexible approach to intellectual property development

The Crick's intellectual property strategy will aim to maximise the uptake and exploitation of knowledge and inventions developed at the Crick. We will operate in a spirit of openness and sharing, managing intellectual property in a way that facilitates interactions and reduces barriers to access, so that laboratory discoveries are turned into inventions and applications that deliver public benefit as quickly as possible.

Some Crick discoveries are likely to attract considerable commercial interest. Other discoveries, for example those related to rare diseases, new prevention strategies, or conditions primarily affecting low-income countries, may be more appropriate to develop in partnership with public or charity funders. For this reason, we anticipate using

a range of approaches to develop intellectual property generated at the Crick. We will work in an integrated fashion with Crick founding partner technology transfer groups and offices, drawing on their expertise, capability and resources. We will also explore opportunities to strengthen intellectual property positions through IP bundling with the three founder universities, working with their established technology transfer operations.

Develop close interactions with industry

Industrial partnerships will be critically important to the Crick in advancing biomedical science. With the pharmaceutical industry increasingly moving to an open innovation model, and turning further to academic research partnerships, there is an opportunity to develop highly collaborative interactions with industry. The Crick will have the ability to interpret the large data sets that human biology, pathology and population studies will generate, which will be of great interest and value to industry and healthcare delivery partners.

We will form high-level strategic partnerships with companies in areas that parallel the research activities within the institute and that promote our translational research agenda. We will work with pharmaceutical and biotech companies to provide the scientific underpinning of new medicines and vaccines, and with medical technology companies where biological insights from our research yield potential new approaches to the diagnosis and early detection of disease. Our aim will be to identify and tackle short and long-term challenges with partners in industry, especially where the Crick and its industrial partners have complementary skills and resources. We expect to locate a proportion of our applied translation work within science parks and incubator units, providing a path for transition of academic research to industry-driven development. The Crick is taking a close interest in the development of the Stevenage Bioscience Catalyst, which has the potential to provide Crick Investigators with a unique opportunity to collaborate with the pharmaceutical industry in drug discovery and development. Unlike conventional science parks, access to the expertise of big pharma in areas including high throughput screening and medicinal chemistry would give Crick Investigators a powerful position in relation to translational science.

We will develop an Industry Programme to provide a forum for interaction and to give greater exposure of Crick scientists to commercial translation and innovation. Through this mechanism, industry partners will be able to take maximum advantage of recent scientific developments at the Crick, with a view to identifying potential collaboration and licensing opportunities. The Crick will benefit from the insight and expertise of the industrial members, gaining a better understanding of industry needs, with the potential to stimulate new research directions.

Promote clinical interactions and clinical translation

To ensure that scientific discoveries generated in the Crick can be rapidly tested in a clinical environment, we will facilitate broad interactions between basic biomedical scientists, clinical scientists, clinicians and epidemiologists. Some of these interactions will take place within the institute, which will include clinically active researchers on staff as well as training for clinical scientists. The goal is to establish a comprehensive 'clinical ecosystem', extending across career levels and bringing together the Crick, the significant experimental medicine facilities and expertise of our university founders, and other research hospitals, universities and relevant commercial organisations as appropriate. High priority will be given to working with the NIHR Biomedical Research Centres and Academic Health Science Centres, which have already developed an extensive resource of expertise and facilities for clinical translation. Reflecting the key role that imaging plays in translational research, an important relationship will be developed with the scientific and clinical imaging communities, specifically at Imanova and the CR-UK/EPSRC funded imaging centres.

Exploit our internal capability for technology development

The application and further development of emerging technologies will be an integral part of Crick activities and will play an important role in enabling our translational and clinical research agenda. Our broad scientific portfolio will create an attractive environment for end-stage development and testing of new technologies. Pioneering biology, combined with multi-disciplinary expertise from physics, chemistry, computing and engineering, will allow the Crick to make contributions to the development of novel medical interventions and technologies, working in close collaboration with its university founders. We expect to create demonstrator laboratories for platform technologies for academia and industry, and opportunities for technology transfer activities in areas such as assay development, application of high-throughput approaches, and compound evaluation.

Pharmaceutical industry, drug production line.
© GEOFF TOMPKINSON/SCIENCE PHOTO LIBRARY

STRATEGIC PRIORITY 5: ENGAGE AND INSPIRE THE PUBLIC

The Crick is committed to an open culture where ideas can be tested and challenges shared to accelerate the creation and use of knowledge. This philosophy also extends to our interactions with the local community and the wider public. The Crick's size, location and profile will make us highly visible and able to play an important role in generating excitement and interest in science, particularly through our engagement and outreach activity with schools. We also have an opportunity to help promote health and wellbeing in the local area and across the country. To achieve these objectives, we will develop inspirational education, public and community engagement programmes, backed by a community of active research scientists who have the skills, opportunity and desire to engage people in their work.

Top: Local school students making lava lamps during science week. © The Francis Crick Institute

Bottom: Crick 'Science Buskers' engaging the public at a local street fair. © The Francis Crick Institute

The Crick will:

Engage in public dialogue about biomedical research, exploring the impact it may have on people's lives, the economy and society

Biomedical science offers profound opportunities to society, but can also raise important questions that require discussion and debate beyond the scientific community. Some of the research areas that the Crick will be involved in, including stem cell research, regenerative medicine and the biology of ageing, will have fundamental implications for our society and its future direction. It is important that our scientists are equipped to contribute to public debate about the direction, purpose and implications of biomedical research. Understanding public aspirations for health and medical research will be of great value to the Crick as we endeavour to translate our scientific discoveries into technologies and treatments that benefit patients.

The Crick will establish an innovative and inclusive public engagement programme that brings together Crick researchers with our neighbours, founders, UK and global citizens to jointly explore the nature and implications of our research. We will engage openly in public dialogue about medical research and its uses, respecting the wide range of perspectives that exist and seeking to build mutual trust. The large number of active and distinguished research scientists working at the Crick and our university founders, and our close links with a range of clinical, medical and academic organisations, will allow us to play an important national role in engaging the public with science, particularly with the way scientific research is carried out.

Our public engagement programme will include visits to the Crick, public lectures, events and commissioned engagement projects, alongside exhibitions and installations in our 450 seat auditorium and exhibition space. We will also develop partnerships to engage national audiences with our research. We will explain the links between research and health and the importance of discovery research, and discuss the methods we use to carry out research.

We will engage with scholars, artists and arts organisations to explore ways to build bridges between science, arts and the humanities. This may include joint activities with our university founders; our near neighbours the Wellcome Collection, the British Library and the University of the Arts London; as well as other London museums and galleries.

Support our staff to engage effectively with the public

We want to encourage as many Crick staff as possible to get involved in public engagement activities. We will enable our scientists to make public engagement an integral part of their research career, recognising that individuals will vary in the amount of emphasis they wish to place on it. Our staff will be supported to engage with a range of audiences, helping to facilitate informed public discussion about biomedical research. This engagement may be face-to-face, through the media or online. It may include engagement with patients, undertaken in partnership with Biomedical Research Centres at the three universities. We will provide training, support and funding for public engagement activities to emphasise the value the Crick places on them and encourage wide participation by staff.

Develop an open relationship with the local community that supports people's aspirations for health and wellbeing

The Crick has an opportunity to become a valued part of the local community through effective and genuine engagement with local people. Our aspirations for our local engagement activity reflect our ambitions for the institute, and we aim to be recognised as a leader in community engagement. We will achieve this by working in partnership with the community, by embedding engagement activity in our culture, and by providing opportunities for our staff to work with the community.

We will take account of the community's needs and aspirations in developing our engagement strategy. Our 'Living Centre', a purpose-built space within the Crick developed and run in partnership with the community, will be important for this. It will help improve health and wellbeing in St Pancras and Somers Town (one of the most deprived wards in London), by offering services such as health checks, advocacy, exercise classes, and adult and community education. In addition, the Living Centre will offer opportunities for the Crick to collaborate with local residents, our founders, and other partners on innovative community and health projects.

Our local engagement programme will also incorporate:

- a schools outreach programme with a strong local focus;
- opportunities for local groups to use the Crick's facilities for community events;
- a teaching laboratory;
- training and employment opportunities;
- promoting improvements to local open spaces and community policing and safety measures;
- health and arts projects co-produced with the community; and
- staff volunteering schemes.

Engage with policy-makers to ensure that the UK remains an attractive environment for biomedical research

The UK has a proud track record in the biosciences, ranking second only to the United States on most measures of scientific excellence. We need to build on this success, encouraging a high level of public and political support for medical research; diversifying the funding opportunities available in the public, private and charitable sectors; improving regulatory environment to support the timely development of scientific discoveries into potential treatments for use in patients; and promoting the UK as a destination for leading scientific talent from around the world.

As an independent organisation funded by the taxpayer and major charities, the Crick can bring a particular perspective to the development of national science and biomedical research policy and regulation. We will influence policy by working with our partners to develop and communicate a coordinated position on relevant policy issues, and by giving policy makers ready access to the scientific and technical expertise available within our institute. We will support our researchers and other staff to engage and communicate effectively with politicians and policy makers.

Increase young people's enjoyment and aspirations in science, and inspire a new generation of learners

Fostering a society equipped to question, challenge and embrace scientific advances begins in the classroom - even the youngest minds can experience the wonder of the natural world. We will work with our founders to help inspire young people to engage with scientific discoveries that will affect them. We aim to become a high quality learning resource for schools and education institutions. We will offer school groups opportunities to engage with our scientists and their research, will provide a teaching laboratory, and will strive to find new and effective ways in which to communicate the importance of biomedical research to a young audience. We will promote the wide range of careers available to students taking Science, Technology, Engineering and Mathematics (STEM) subjects.

We will provide accessible, contemporary and relevant activities for a wide range of learning audiences. This will include student mentoring opportunities and work placement/experience schemes; scientific lectures, demonstrations and debates; laboratory tours; laboratory demonstrations and experimental opportunities; and a range of outreach activities including projects, partnerships and competitions.

OUR SCIENCE PROGRAMME

OUR SCIENCE PROGRAMME

The Crick's vision is to discover the biology underlying human health, improving the treatment, diagnosis and prevention of human disease. This encompasses the main causes of human mortality and morbidity including, for example: cancer; circulatory and respiratory disease; infection; nutritional and metabolic diseases; ageing and degeneration; neurological disorders; immune diseases and developmental disorders. By working closely with the three university founders and taking advantage of complementary expertise and skills, we will deliver important advances in our knowledge of human biology in health and disease.

Increasing molecular knowledge has provided new ways of classifying disease, revealing overlaps between diseases previously thought to be distinct, and repeatedly demonstrating that insights into one disease can increase understanding of others. We will therefore undertake discovery research across the range of human disease. The span and diversity of research at the Crick, plus the ability to interact freely with scientists and other academics associated with the three university founders, will promote cross-fertilisation between studies of different diseases and novel approaches to scientific enquiry.

Top: Preparing DNA samples for high throughput sequencing. © The Francis Crick Institute

Bottom: Dissection under a microscope. © The Francis Crick Institute

Over time, given its size, the Crick will carry out a broad range of research. To be effective in delivering its mission the Crick needs to be highly responsive, identifying emerging and promising areas in a timely fashion. The relatively high levels of turnover and consequent fresh recruitment will allow the Crick to achieve this, avoiding the stasis that can arise in more conventional research institutions. The Crick will develop its research programme as follows:

1. High level broadly-based research themes will be identified, encompassing a range of different research programmes and projects.

2. Experimental approaches needed to undertake research within the institute will be identified and kept under review.

3. The best scientific athlete approach will be used for recruitment; identifying the person and the research programme they intend to follow at the same time.

4. Small satellite laboratories will be developed, hosted by the Crick or the three university founders. Satellites will allow external partners to collaborate effectively with Crick researchers (or vice versa), facilitate application of Crick research, and allow Crick researchers access to external research facilities.

5. Horizon scanning and reviews of research portfolios and experimental approaches will be carried out regularly (every 1-2 years) to identify promising and emerging areas, and gaps in group leader recruitment. Seminar and lecture programmes will be used to inform the Crick of research areas that are new or not well represented at the institute.

6. Research programmes pursued at the Crick will interact with the existing and evolving strategies of our six founders, and take account of the views of our collaborators in biomedical research, the NHS and the health care industries.

The Crick will open its doors in late 2015, and it is now appropriate to define the broad research themes that will guide the science carried out. These are presented here as high level science questions, which will be pursued using a range of experimental approaches. The Crick clinical research programme will evolve through discussions and engagement with our university founders, and through the appointment of senior clinical scientists. Ensuring that the knowledge gained through exploration of our science questions is appropriately tested and translated into clinical research, and ultimately into benefits for patients, is of particular importance to the Crick.

The diagram summarises our science questions and experimental approaches

Science questions - cross-cutting

Science questions - thematic

Experimental approaches

SCIENCE QUESTIONS

Our research programme is defined by high level questions, reflecting both the current research strategies of our founders and major issues of interest in biomedical research.

We have identified seven questions, of which the first three are cross-cutting and overlapping:

One

How does a living organism acquire form and function?

Two

How do organisms maintain health and balance throughout life and as they age?

Three

How can we use biological knowledge to better understand, diagnose and treat human disease?

The remaining four questions are more thematic:

Four

How does cancer start, spread and respond to therapy?

Five

How does the immune system know whether, when and how to react?

Six

How do microbes and pathogens function and interact with their hosts?

Seven

How does the nervous system detect, store and respond to information?

The following pages briefly explore these questions, setting out more specific focus questions associated with each of them.

Crick symposium on 'Metabolism in health and disease'. © Wellcome Images

Investigating early growth and embryonic development in the zebrafish, NIMR. © The Francis Crick Institute

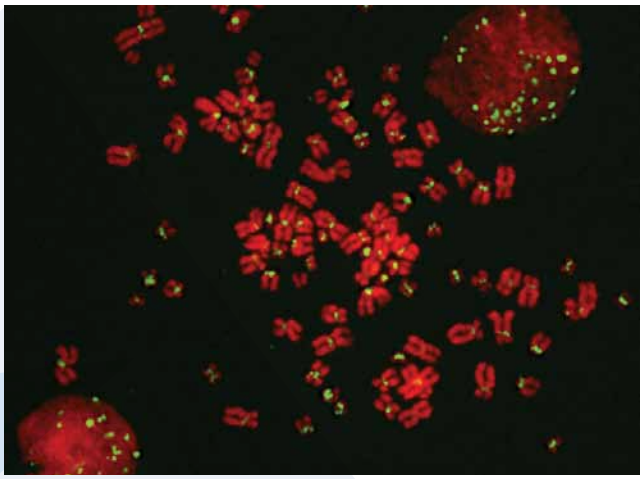
QUESTION 1: HOW DOES A LIVING ORGANISM ACQUIRE FORM AND FUNCTION?

- **How does a cell's behaviour reflect the properties and organisation of its constituent molecules?**
- **How do DNA sequences and the architecture of the genome encode functional traits?**
- **How are diverse cell types generated at the right time and location?**
- **How are cells assembled into tissues and organs?**
- **How do cells, tissues and organs communicate with each other during development?**
- **How do organisms respond to their environment during development?**
- **How does metabolism affect cell function?**

Understanding the intricate processes that allow living organisms to develop and operate properly is essential for understanding human health and disease and for progress in regenerative medicine. Errors in embryogenesis result in birth defects and can contribute to illness later in life. Similarly, defects in metabolism, macromolecular synthesis and cellular homeostasis can give rise to a range of human diseases. As many developmental and cellular processes are conserved throughout the animal kingdom, studies of model organisms can inform the equivalent processes in human beings.

Cells are central to this and the next question, as the fundamental units of life that make up all living organisms. Precise control of cellular communication and embryogenesis is necessary to organise cells into tissues and organs and to allow a functioning organism to develop. A cell's behaviour is determined by its constituent molecules, generated by metabolism and by macromolecular synthesis and breakdown. Key to these processes is the regulation of gene expression, acting through transcription, translation and other mechanisms. Cells respond to physical signals generated by interactions with other cells and with the surrounding extracellular matrix. These signals control tissue growth and help shape organs. Identifying them will be important in our understanding of how organs form and tumours develop.

Metabolism provides cells with energy, enabling them to convert dietary materials into the molecules required for growth and maintenance of the body. Defects in metabolism can cause a deficiency of molecules needed for normal cellular function or a build-up of toxic substances, so it is very important to understand how metabolism works and is regulated. In addition to its role in metabolic disorders such as diabetes, it is becoming increasingly clear that metabolism is important for a range of other diseases, including cancer.



Colorectal cancer cell line metaphase chromosomes. © The Translational Cancer Therapeutics lab, LRI

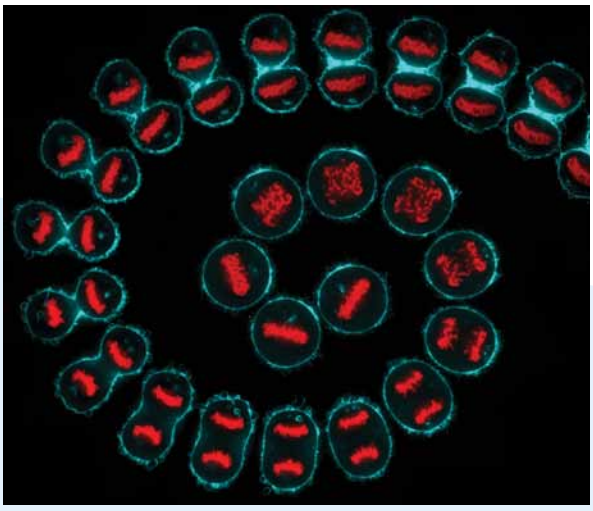
QUESTION 2: HOW DO ORGANISMS MAINTAIN HEALTH AND BALANCE THROUGHOUT LIFE, AND AS THEY AGE?

- **How does a living organism maintain itself through homeostasis?**
- **What causes molecular, cellular and organismal ageing, and how does the germ line escape it?**
- **How do organisms sense and respond to stress?**
- **What safeguards the accurate duplication and segregation of genomes?**
- **How do cells detect and repair DNA damage?**
- **How do cells manage damage to proteins and organelles?**
- **How can cells be reprogrammed and used to repair or replace damaged tissues or organs?**
- **How do organisms respond to tissue and organ damage?**

Homeostasis describes the ability of living organisms to maintain themselves and their internal environment in constant conditions, in a changing environment. Over time homeostatic mechanisms break down and organisms accumulate damage, leading to ageing and degeneration. The resulting cellular damage and tissue degeneration are major contributors to human disease, including neurodegenerative diseases, cardiovascular disease and cancer.

Effective maintenance of genome integrity is an important aspect of homeostasis. Each time a human cell divides three billion base pairs of DNA, contained within forty-six chromosomes, have to be accurately replicated and the resulting pairs of sister chromatids faithfully distributed. This is already a challenging task, but DNA can also be damaged by the numerous external insults cells experience, including starvation, chemical and radiation damage and mechanical stress. Various mechanisms are in place to ensure effective duplication and segregation of the genome and the detection and repair of DNA damage. Similarly, processes exist that detect and repair damage to other cellular components, tissues and organs. All of these processes are dependent on mechanisms that allow cells to detect abnormal external conditions or damage to cellular components, and mount an appropriate response, whether repair, cell death, or growth arrest. Understanding how tissues and cells respond to damage has important implications for many diseases, including cancer (when defective cells fail to be eliminated) and neurodegenerative disease (when damage is not repaired).

Many tissues harbour a small pool of stem cells that act as a reservoir to repair damage or replace lost cells Understanding the molecular mechanisms that control stem cell behaviour, ensuring they produce the correct types of cells in the right numbers to repair a tissue, will aid their effective use in therapy.



Time-lapse microscopy to show a cancer cell (HeLa) undergoing cell division (mitosis).© Kuan-Chung Su and Mark Petronczki, LRI

Preparing single worms for mutational analysis by high-throughput sequencing, LRI. © The Francis Crick Institute

Volunteer breathing into a calorimeter to measure energy expenditure for a study on fibre and appetite at the NIHR/ Wellcome Trust Imperial Clinical Research Facility.
©Thomas Angus

QUESTION 3: HOW CAN WE USE BIOLOGICAL KNOWLEDGE TO BETTER UNDERSTAND, DIAGNOSE AND TREAT HUMAN DISEASE?

- **How can we investigate human physiological processes to inform basic biological models and vice versa?**
- **How can realistic human tissue and organ model systems be constructed in the laboratory?**
- **What can be learnt from the increasing wealth of human genomics data?**
- **How can variation in individual responses to therapies be explained?**
- **What is the effect of ageing on human cells, tissues and organs, and how can healthy ageing be promoted?**

This question covers the investigation of human beings and what goes wrong in disease. It covers a wide range of biology and medicine, and includes many opportunities for future development of additional thematic areas, for example to exploit the strengths of the university founders in cardiovascular biology and medicine. It involves both human observation and experimentation, and exploring how knowledge acquired from studies of other living organisms can be applied more effectively to humans. Better studies of human beings in health and disease will improve our understanding of how we function, and help to translate improved biological knowledge into applications that improve patient and population health.

Better methods of studying humans need to be developed, including laboratory-based tissue and organ model systems as well as non-invasive body imaging. Induced pluripotent stem cells (iPS cells) offer opportunities to study human diseases in vitro. By making iPS lines from patients with specific diseases and differentiating them towards cells relevant to that disease, it will be possible to study biological pathways that are perturbed. Testing compounds that correct or inhibit these pathways may help identify new treatments for human disease. Advances in 3D scaffolding technology will enable more complex entities to be grown in vitro, and it is also possible to 'humanise' animal models to make them more reflective of human disease. Using these new models, we can determine the effect of the perturbation of specific molecular pathways in vivo.

Genomics and high-throughput sequencing have provided large genomic data sets from well-characterised groups of human patients. By comparing these patients with healthy controls it is becoming possible to establish how genetic and environmental factors interact to maintain health and promote healthy ageing, and also cause disease. Links with its university founders will allow the Crick access to large cohort studies, amenable to transcriptional analysis of mRNA, microRNA and other non-coding RNAs and DNA. Integrating this with clinical data and environmental factors will help to delineate pathways underlying pathogenesis and health.

A systems biology approach to the analysis of complex clinical data sets, before and after disease onset, will help to define potential pathways of disease pathogenesis. Whole body and tissue specific non-invasive imaging will also allow the accurate modelling of disease processes. The university founders have access to substantial facilities that will allow detailed definition of physiology and pathology in real time at whole organismal levels. New modalities of imaging and the further development of molecular probes will become increasingly important. This area will provide rich opportunities for partnership with the pharmaceutical and biotech industries.

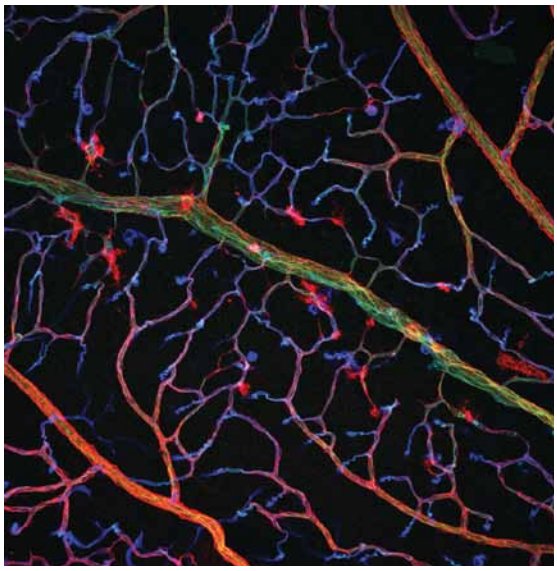
QUESTION 4: HOW DOES CANCER START, SPREAD AND RESPOND TO THERAPY?

- **What genetic, cellular and physiological changes govern cancer development and spread?**
- **How are the genetic changes associated with cancer development generated?**
- **What are the evolutionary pressures governing tumour development and spread, and the response to therapeutic intervention?**
- **What role does inflammation play in the initiation and development of cancer?**
- **How does interaction with the surrounding stroma facilitate tumour development?**
- **What determines cancer cell dissemination and metastasis?**
- **How do we predict which tumours will progress and which will respond to therapies?**

Cancer is a major cause of human morbidity and mortality. It covers over 200 highly complex diseases in which cells proliferate uncontrollably, usually as a consequence of somatic genetic mutations. While advances in cancer genomics are speeding the identification of genetic changes in developing tumours, our understanding of the functional significance of these changes is more rudimentary Determining the contribution made by particular genetic drivers to the cancer phenotype requires understanding the function of cancer genes themselves at the cellular and biochemical level, and the regulatory networks in which they operate, and will reveal new opportunities for therapeutic intervention.

Tumour cells constantly engage with non-cancerous cells, including leukocytes, endothelial cells and fibroblasts. These regulatory networks provide opportunities for intervention, and therapies targeting endothelial cells and blood vessels and the immune system have recently become a clinical reality. Inflammation can suppress cancer by promoting immune attack. However, there is ample evidence that it can also contribute to the carcinogenic process. Definition of these pathways at the molecular level will allow enhancement of host protection and the development of new immunotherapies.

In many cases cancer cells will already have spread throughout the body at time of diagnosis, and can remain indolent and non-symptomatic for many years. Effective cancer treatment requires that we understand the factors that trigger the re-activation of disseminated cancers. Some tumours may initially respond to therapy but then develop resistance, and others do not respond at all. Learning which tumours will respond to which therapies will ensure that people with cancer receive the most appropriate therapy and do not receive unnecessary treatment.



Laser scanning confocal microscopy image highlighting the blood vessels of a mouse retina. © Claudio Franco and Holger Gerhardt, LRI

Discussing experimental results in the Translational Cancer Therapeutics Laboratory, LRI. © The Francis Crick Institute

Staff and PhD students in the Infection and Immunity research laboratories, King's College London © King's College London

QUESTION 5: HOW DOES THE IMMUNE SYSTEM DETERMINE WHETHER, WHEN AND HOW TO REACT?

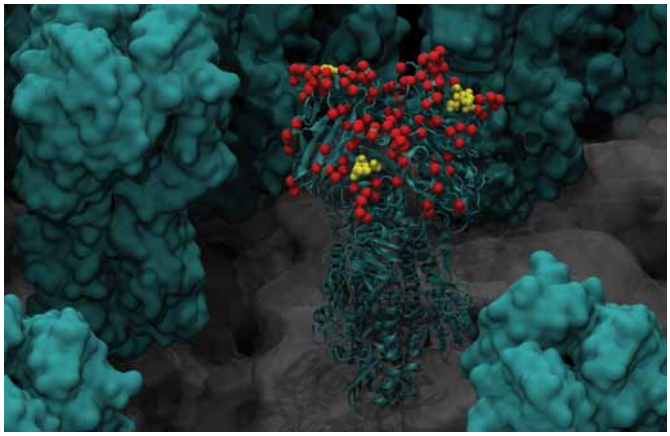
- **What processes underlie immune system activation and regulation?**
- **How does inflammation promote or prevent disease?**
- **How can we vaccinate to create long-lasting immunity?**
- **How does the immune system fight pathogens but tolerate commensals?**
- **How does metabolism affect the immune response to infection?**
- **How do cancer cells avoid host immune attack?**

The immune system is the human body's major defence mechanism, crucial both to combat pathogens and to defend against cancer. Malfunctions of the immune system increase susceptibility to infection and to autoimmune diseases.

Humans recognise invasion by different classes of pathogens by using evolutionarily-conserved pattern recognition receptors. These drive the process of cell activation resulting in immunity. Inflammation without an obvious microbial cause is a major component of diseases as diverse as obesity, atherosclerosis, chronic obstructive pulmonary disease (COPD), neurodegeneration and cancer. It is likely that many human diseases share an inflammatory component. Understanding the cells, signals and receptors that drive inflammation, as well as the mechanisms that control and oppose it, is central to harnessing 'useful' inflammation while preventing its damaging effects.

Our internal gut microflora, and environmental factors such as diet, play a central role in immune homeostasis and immune reactivity. Microflora and diet also influence body weight and insulin-resistance, notably by acting on adipose cells. Disturbances in metabolism, including obesity, may be associated with an inflammatory state with effects on the innate immune system. Understanding how nutrient-derived and metabolic factors influence the innate and adaptive immune systems, including the gut and its associated bacterial flora, is an important goal for biomedical research.

The immune system is able to recognize some cancer cells as foreign or abnormal and then eliminate them. However, many cancer cells escape immune recognition and suppress the immune response and thus are at a selective advantage. In addition, inflammatory responses, which would normally combat pathogens, may promote the invasive behaviour of tumours and suppress anti-cancer responses. A deeper understanding of the molecular mechanisms of tumour eradication or promotion by immune and inflammatory responses may lead to the development of new therapies for cancer.



An image of the influenza virus surface in 3D based on data from electron cryotomography. © Sebastian Wasilewski and Lesley Calder, NIMR

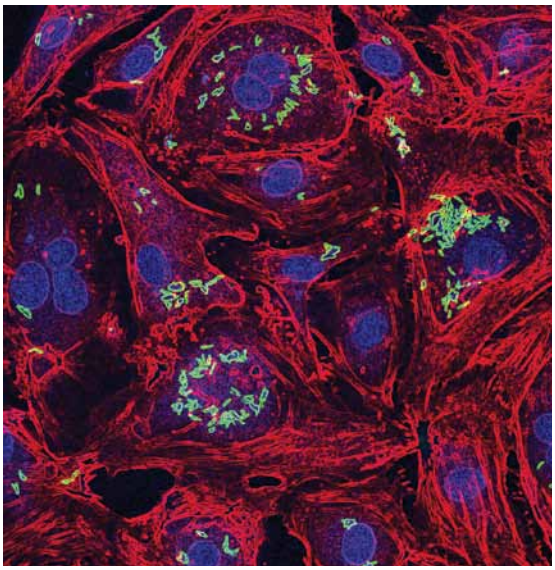
QUESTION 6: HOW DO MICROBES AND PATHOGENS FUNCTION AND INTERACT WITH THEIR HOSTS?

- **What makes a microbe pathogenic?**
- **How do pathogens invade, grow in and escape from hosts?**
- **How does evolution shape host-pathogen interactions?**
- **How do pathogens withstand the host immune system?**
- **What factors determine individual patient response to pathogens?**

Infectious diseases remain a significant challenge to human health, accounting for about a quarter of all deaths worldwide, the majority of which occur in low-income countries and amongst children. A significant proportion of human cancers, including those of the cervix and stomach, are likely to have a microbial or viral cause. Research at the Crick will improve our understanding of a wide range of pathogenic organisms, exploring the complex interactions between pathogens, commensals and the host.

The relationship between pathogens and their hosts can be viewed as an evolutionary arms race, with host and pathogen each developing specific countermeasures. The development and application of high-throughput sequencing techniques, combined with new bioinformatic analysis tools, will make such changes easier to identify. By identifying potential points of molecular conflict between host and pathogen, this work will inform areas for molecular analysis and drug development. As pathogens also evolve in response to chemotherapeutic treatments, studying the development of resistance will help maintain and improve the effectiveness of current drug regimens.

The outcome of an infection by a given pathogen will vary significantly, depending on factors related to both the host and the microbe. Host genetic differences identified in population or case studies can be studied in the laboratory using transgenic systems. Laboratory-based model systems can be used to explore the impact of non-genetic factors, such as co-infection by two pathogens. Environmental factors, such as ambient temperature or sunlight exposure, can also have effects on pathogen and vector growth as well as on host responses.



Images of cells infected with mycobacteria. © Dr. Maximiliano Gutierrez, NIMR

Cells are counted under a microscope to determine host cell to parasite ratios, NIMR. © The Francis Crick Institute

Neurologists assess a scan of the brain, UCL Institute of Neurology ©UCL Creative Media ServicesServices

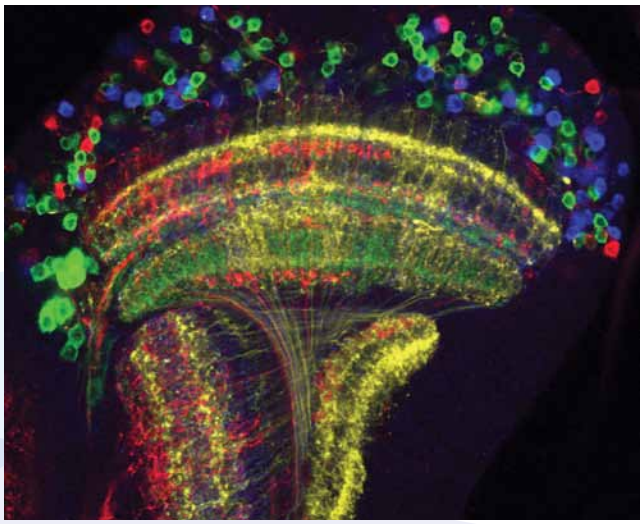
QUESTION 7: HOW DOES THE NERVOUS SYSTEM DETECT, PROCESS AND RESPOND TO INFORMATION?

- **What are the mechanisms of sensory information processing and storage?**
- **How does the nervous system interact with other organ systems?**
- **What are the organising principles of brain wiring?**
- **How does brain development influence its function in the adult organism – in health and in disease?**
- **How does the immune system contribute to homeostasis in the nervous system?**

The functioning of the nervous system presents some of the most important and challenging questions in biology. Neurodegeneration, which causes debilitating conditions including Alzheimer's and Parkinson's disease, is one of the major causes of human morbidity and mortality, and this burden is expected to increase as our population ages. However, the complexity of nervous systems means that progress in understanding the mechanisms of disease and potential therapeutic approaches has been slow. Crick research will have an emphasis on simpler vertebrate and invertebrate models which offer opportunities to tackle this complexity, complementing our university founders' expertise in human and rodent models. There are opportunities to combine sophisticated imaging with the study of sensory inputs and behavioural outputs.

The brain and nervous system orchestrate and calibrate the function of all other tissues in the body. Without neural inputs, organs do not work properly together, and metabolic diseases such as diabetes can result. Conversely, aberrant chemical signals from the body, such as those generated by unhealthy diets, disrupt brain function by suppressing normal sleep-wake rhythms. Links between brain and body are mediated by neural networks that originate in the hypothalamus. Understanding what regulates such circuits will help us to develop better strategies for dealing with common problems such as obesity, insomnia, and neuropsychiatric disorders.

The brain is protected by an immune system just as other organs are. Many diseases of the brain, from Alzheimer's to Multiple Sclerosis, have an inflammatory component. The role of the immune-inflammatory system in the central nervous system may go further than functioning to protect against insults, or causing disease through over-activity. It may also regulate normal homeostatic functions and hence the function of the brain itself.



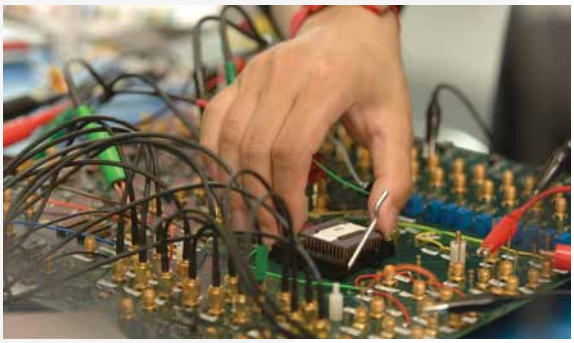
Neurons in the adult Drosophila visual system. © Dafni Hadjieconomou and Iris Salecker, NIMR

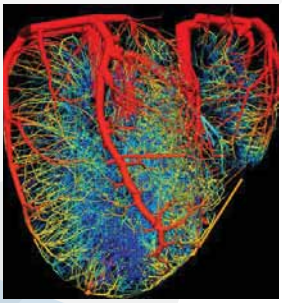
EXPERIMENTAL APPROACHES

The Crick will facilitate the development of effective technical and conceptual approaches, combining existing biomedical research technology with new and emerging disciplines, including approaches not traditionally associated with biomedical research.

We will work closely with our three university founders, drawing on their multi- and inter-disciplinary expertise to develop new analysis, measurement and calculation and imaging tools for biomedical research. We will also develop a strategic alliance with the Wellcome Trust Sanger Institute, linking their focus on large data sets and biological resource production with the more hypothesis-driven research at the Crick.

We will place a strong emphasis on computational methods, which are central to the effective handling and integration of the large biological and biomedical data sets, and on the generation of models of biological phenomena. Our interactions with other research institutions and medical facilities, both locally and world-wide, will ensure that our researchers have ready access to the expanding international genomic and bioinformatic resources.





Top: Working on Cochlear implant channels and temporary derivative CNN vision processors © Imperial College London

Bottom left: A computational model of the coronary arteries, Departmental of Biomedical Engineering, King's College London

Bottom right: Mass spectrometry equipment. © The Francis Crick Institute

Structural biology and biophysics

As structural approaches have become more sophisticated, the characterisation of macromolecular structures has become relatively routine. Future needs will involve new approaches on a range of dimensional scales, from the visualisation and manipulation of single molecules and their behaviour, to elucidating structures of assemblies visible under conventional light microscopy. Techniques will include X-ray crystallography, Nuclear Magnetic Resonance, and cryo-electron microscopy.

Imaging

Imaging of organs, cells or molecules all levels of resolution is a powerful way to investigate biological processes. Increasingly, imaging of living organisms will allow real time analysis to support studies of human physiology, pathology and pharmacology.

The Crick will provide a multi-disciplinary environment in which biologists, clinicians, chemists, physicists, engineers, computer scientists and mathematicians work together. Next generation imaging and measurement/sensing techniques will be used, together with bioinformatic tools generated for the analysis of complex image data sets. These techniques will include advanced optical imaging, photoacoustic imaging, MRI, PET, SPECT and radiochemistry for radiochemical imaging, X-ray and CT imaging. Use will be made of automated time lapse imaging using live cells and organisms for both analysis and screening.

Cell biology

Advancing understanding of cell structure and function will underpin many areas of investigation at the Crick. Of particular importance will be live imaging of cells. We will use stem cells as a powerful tool for regenerative medicine and for new technical approaches to the study of disease. Induced pluripotent stem (iPS) cell technology will be used to provide specific cell types derived from an individual (human or a model organism) with a known genotype or phenotype.

Genetics and genomics

The Crick will take advantage of the capacity to readily obtain genomic sequences for human populations, animal models, pathogens and microbes, to develop hypotheses about biological mechanisms in health and disease. We will work with the universities and the Wellcome Trust Sanger Institute and will use data from genome-wide association studies (GWAS), genome sequencing, global analyses of gene functional states, and epigenetic approaches.

Biochemistry and proteomics

The Crick will use a variety of biochemical and proteomic approaches. Biochemical reconstitutions of processes with a defined set of factors will be used to assist full mechanistic explanation, using natural components and artificial entities through synthetic biology. We will use multiple global analytical tools including genomics, proteomics, informatics and metabolomics to identify constituents and interactomes relevant for understanding biological processes. These tools will be underpinned by peptide synthesis, peptide arrays, large scale cell production and fermentation of microorganisms.

Human biology and physiology

The Crick will develop a new programme of human biology and physiology to provide a better and wider platform for translational activities and more consistently deliver improvements in human health. This programme will promote human physiology research in general, and will include specific initiatives in whole body and organ imaging; constructing more realistic tissue and organ model systems in the laboratory; and using human genome sequences to frame biological questions that can be experimentally investigated.

Computational, theoretical and systems biology

The Crick will provide access to mathematical and physical reasoning to assist investigation and interpretation of high- throughput and quantitative data and the development of predictive mathematical models and hypotheses of biological processes in terms of their behaviour as systems. These approaches will also be used to link large biological data sets with clinical records, integrating genomic and phenotypic information and assisting the generation and testing of mechanistic hypotheses about health and disease. Experimental physics and engineering will be harnessed to provide new ways to tackle biomedical problems.

Chemistry and high-throughput technologies

Chemical tools and technologies will be provided at the Crick, including chemical probes and derived biomolecules for functional analyses and imaging. High-throughput technologies and access to diverse chemical libraries will be available to identify and develop chemical probes to investigate biological problems and to generate pharmaceutical lead compounds. This area will provide an important opportunity for collaboration with industry scientists.

Synthetic biology

Synthetic biology will be used to design and engineer biologically-based parts, novel devices and systems as well as redesigning existing, natural biological systems. This will allow the application of systematic design, applying the engineering principles of modularisation, characterisation and standardisation. The approach allows the construction of novel artificial biological pathways, organisms or devices, or the redesign of existing natural biological systems. To illuminate the design principles underlying the control system, the reverse approach of simplifying complex regulatory networks while maintaining core biological function will also be used. New pathways for making chemicals and antibiotics will be characterised by cloning environmentally-derived DNA, or 'eDNA', in expression organisms.

Microfabrication and bioengineering

The Crick will provide facilities to enable the construction of novel appliances in which cells, tissues, and biochemical reactions can be manipulated on a microscale in predictable and reproducible ways. These will include the manufacture of cell biology micro-devices to promote cell or tissue growth in particular two- or three-dimensional arrangements, to allow delivery of reagents or stimuli to particular areas, or to allow directed application of environmental stresses. Applications will be made in both human and animal model contexts, including the development of artificial organs.

Model organisms

The Crick will use model organisms ranging from viruses to vertebrates. This will include models of human genetic, immunological, infectious and degenerative disease, in addition to regenerative medicine and behavioural studies. We will seek to develop the means to validate the conclusions derived from such models in the human context, including the use of 'humanised' models. Germ-free animal facilities will enable analysis of host: microbiota interactions. Invertebrate model systems will be used to investigate neurobiological problems.

Ecology, evolution and ethology

Biomedical research has not always taken sufficient account of higher levels of biological organisation that can influence our understanding of how living organisms, organs and cells work. The application of concepts and thinking from levels of organisation such as ecology, evolution and ethology to biomedical research problems will be encouraged at the Crick. These approaches will also be helpful in studying the effects of climate change on global health.

DELIVERING OUR AGENDA

DELIVERING OUR AGENDA

We are an independent charity, and will operate in accordance with UK charity rules and regulations. To optimise the delivery of the scientific agenda outlined in this Strategy, we will develop a distinctive culture, with effective leadership and governance and strong engagement from staff across the organisation, and from the university founders. Developing robust and effective internal systems will be a major priority for the Crick as we prepare for our 2015 opening. As we move towards opening, we will develop an implementation plan linking our strategy with operational and financial plans.

Governance

It is essential that the Crick maintains robust formal governance mechanisms that are consistent with UK charity regulations and have the confidence of the Crick founders and funders.

The Crick Board is responsible for the management of the institute's activities, covering all aspects of our establishment and operation. Each of our six founders nominates a director to the Board, who sits alongside the five independent directors. The Crick Director is responsible for interactions with the Board and funders, as well as all aspects of the institute's operations including science strategy, recruitment, resource allocation and management. An Executive Board will support the Director, including a Chief Operating Officer, Finance Director and Research Directors. The last will include scientists experienced in the management of clinical translation and innovation.

We will develop a light touch management structure that maximises opportunities for scientific staff to engage with the day-to-day running of the institute. Formal engagement mechanisms will include an appointed Research Directorate and an elected Faculty Council, as well as bottom-up-organised 'interest groups' which will promote specific research areas and organise seminars, lectures, workshops and conferences. Internal social networks will enable staff to share information and ideas. Within the building, small groups of co-located scientific staff will ensure that local needs are heard and addressed by management, and promote social interaction and sharing of research facilities.

Science review and quality assurance

The Crick will set and maintain the highest research standards. Our review process will include a review of the institute every six years, based on international independent peer review. The reviewers will include both specialists and generalists experienced in running research institutions. This institutional review will be owned and managed by the Crick founders, in communication with the Crick Board. It will provide a mechanism for the founders to monitor and influence the scientific direction of the institute.

The global institute review will be informed by rolling reviews of our programme leaders, using processes acceptable to our founders. These rolling reviews will inform promotion and resource allocation decisions, as well as enabling us to monitor the evolution of our scientific portfolio. Senior Investigators will be subject to external review on a six yearly basis, which will determine their resource allocation and retention. Assistant Investigators will be reviewed at six years to determine their progression to Associate Member positions, while Associate Members will receive an exit review shortly prior to completing their 12 year term.

A scientific advisory board, composed of leading international scientific experts acceptable to our founders, will provide advice to the Crick Director and Board on all scientific matters. It will also be available to advise the founders, including in the context of the institutional review process.

Culture

We will create a collaborative and open culture that fosters links between the Crick, the founders and the wider scientific community, including researchers, clinicians, industry and the public. Open, timely and consistent internal communications will help us bring together staff from the existing institutes, promoting widespread employee engagement and alignment with the vision for the Crick. We will develop a variety of communications tools to support a creative internal culture where staff connect and collaborate.

Recruitment, training and organisational development

Our approach to learning and development is strongly informed by our cultural values. We want to create an organisation that is adaptable and open to learning, with a strong tradition of internal mentoring and support and a focus on excellent science and scientists.

The Crick will assimilate excellent scientists from NIMR, LRI and the university founders, which have complementary scientific expertise. To deliver our translational agenda we will require a critical mass of outstanding clinically-qualified scientists, who can act as mentors for clinician scientists at all levels, and work with non-clinical scientists to identify and progress potential translational opportunities. Identifying high quality physical scientists with an interest in working across disciplinary boundaries will also be critical. These will be important recruitment priorities in our early years of operation. While many clinical and physical scientists will be jointly appointed with our university founders, we will encourage them to develop their laboratory base and centre of gravity at the Crick.

The Crick will recruit from a global talent pool for our group leader positions. We will differ from many scientific research organisations in that the majority of our scientific recruitment will be focused at the early career stage - many of our Assistant Investigators will be embarking on their first independent post. In addition to developing their research and technical skills, we will also support our group leaders to develop their broader leadership potential. For example, this may encompass tailored training in areas such as teaching, people management, engaging effectively with the public and the media, preparing grant applications and financial management. Our more senior group leaders will be expected to assist actively in this mentoring process. We will also encourage our staff to engage in activities led by our founder organisations, such as education and outreach, fundraising, science strategy and policy development.

Outreach

To establish our role as a national institute that supports the UK science and innovation endeavour, we will build extensive networks and relationships across the UK and internationally. We want to communicate in a way that informs, excites and engages our audiences.

We have already spoken to a number of universities and research institutes across the UK to explore how they want to work with the Crick. These discussions will continue as we progress towards opening. We are also speaking to potential industry partners. We have already begun hosting lectures and scientific retreats to promote Crick science and highlight opportunities for collaboration.

Our size and international profile will make the Crick a natural point of contact for international research organisations and life science companies wishing to strengthen ties with the UK. We have already hosted several international delegations keen to hear about our plans and explore potential collaboration opportunities. As we develop our networks, we will be in a position to connect these foreign partners to potential collaborators across the UK.

Cancer Research UK has developed a fund-raising campaign to finance its share of the Crick project. Crick scientists will continue to assist with these efforts and with fund-raising more generally in the future.

Transitional management systems

As we progress towards our 2015 opening, we need to establish all the business functions necessary for an organisation with the Crick's size and scale, combined with appropriate mechanisms for internal resource allocation. Our priority is to develop flexible and adaptable systems that support the ways our scientists want to work. We will devolve responsibility to our scientific staff where possible, enabling them to develop a broad set of management and leadership skills which they can apply in their future careers.

A particular focus will be on developing a high performance ICT infrastructure, with the emphasis on access to technology anytime, anywhere across the institute. We see effective and innovative ICT as a critical enabler of the inter- and multi-disciplinary working that we want to promote. We will need to future-proof our systems to support increases in demand for data production, storage and analysis.

Aerial view of the proposed building and the surrounding area. © Cityscape

OUR FOUNDERS

The establishment of the Francis Crick Institute has been made possible by an innovative partnership between a UK Government funding agency, two charities and three leading universities. Our founders are individually recognised for the support they provide to biomedical research and their strong track record of achievement. By joining forces and coordinating activities at the Crick, the founders are ensuring that even more will be achieved in the future.

Top: View across the Brill Place-Midland Road junction. © Justin Piperger Photography/Wadsworth3d

Bottom: Collaboration space at the Crick. © HOK and Glowfrog Studios

Medical Research Council

The Medical Research Council (MRC) has been at the forefront of scientific discovery to improve human health. Founded in 1913 to tackle tuberculosis, the MRC now invests taxpayers' money in some of the best medical research in the world and across every area of health. Twenty-nine MRC-funded researchers have won Nobel prizes, and MRC scientists have been behind such diverse discoveries as vitamins, the structure of DNA, and the link between smoking and cancer. Today, MRC-funded investigators in universities, centres, units and institutes tackle some of the greatest health problems facing humanity, from chronic diseases associated with ageing to the threats posed by rapidly mutating micro-organisms.

The MRC's largest institute, the National Institute for Medical Research, is dedicated to studying important questions about the life processes that are relevant to all aspects of human health. Its mission is to carry out innovative high quality biomedical research; to train the next generation of medical researchers; to translate its work; and to engage the public in biomedical research.

The MRC Centenary Timeline chronicles 100 years of life-changing discoveries: www.centenary.mrc.ac.uk.

Cancer Research UK

Cancer Research UK is the world's leading charity dedicated to cancer research. Its vision is to bring forward the day when all cancers are cured.

Cancer is the UK's biggest premature killer and more than 1 in 3 of us will develop cancer at some point in our lives. As the population grows and ages, the number of people diagnosed with the disease is predicted to rise steeply. But despite this, more people are beating cancer than ever before, thanks to research.

Cancer Research UK's research is funded entirely by the public, whose donations support over 4,000 scientists, doctors and nurses across the UK. Several hundred of these scientists currently work at Cancer Research UK's London Research Institute (LRI) and will become part of the Crick. The LRI has an international reputation for cancer biology research and has been the source of many significant breakthroughs.

Cancer Research UK scientists have laid the foundations for the UK's national screening programmes. The charity has contributed to some of the world's most important cancer drugs, and improved radiotherapy and surgery to help more people survive. It also lobbies government to keep cancer at the top of the political agenda and to help people spot the symptoms and reduce their risk.

Wellcome Trust

The Wellcome Trust is a global charitable foundation dedicated to achieving extraordinary improvements in human and animal health. It was created in 1936 on the death of Sir Henry Wellcome and remains independent of both political and commercial interests. The Trust's breadth of support includes public engagement, education and the application of research to improve health.

The Wellcome Trust has made a major contribution to research over the decades, supporting the brightest minds in the biomedical sciences and the medical humanities and building world-class research environments in universities and other institutions. As well as being a founder and contributing to the cost of establishing the Francis Crick Institute, the Wellcome Trust will also support research within the institute.

UCL (University College London)

UCL is London's global university, located close to the Francis Crick Institute in one of the world's most dynamic cities. Founded in 1826, it is a research and teaching powerhouse, focused on the translation of research to address the world's biggest challenges.

UCL School of Life and Medical Sciences (SLMS) brings together four faculties to create one of the largest and most prestigious centres for life, medical, brain and population health sciences. SLMS fosters a truly multidisciplinary approach, working in close collaboration with UCL's Faculties of Maths and Physical Sciences and Engineering to respond to real world issues.

UCL is also a founding partner of UCLPartners, an accredited academic health science system established to harness academia to improve population health, in London, nationally and beyond. Drawing together academic strengths and prestigious partner hospitals, UCLPartners' objective is to enable new discoveries in basic science to be translated into treatments more quickly; delivering proven innovation into practice at scale, both to improve patient and population health outcomes, and to generate wealth for the nation.

Imperial College London

Imperial College London is a science-based university with a reputation for excellence and impact that is consistently rated among the world's best.

Imperial's research explores the interface between science, medicine, engineering and business, delivering practical solutions that improve quality of life and the environment, underpinned by a dynamic enterprise culture.

Since its foundation in 1907, Imperial's contributions to society have included the discovery of penicillin and the foundations of fibre optics. Its commitment to the application of research for the benefit of all continues today, with focuses including interdisciplinary collaborations to tackle climate change, and mathematical modelling to control the spread of infectious diseases.

Imperial's partnership with Crick will provide access to bespoke research facilities, technology innovation, a multidisciplinary approach to research and training, and an entrepreneurial culture based on a strong track record in technology transfer and forging relationships with industry.

Imperial's Academic Health Science Centre and the Research and Translation Hub to be built at Imperial West will offer the Crick valuable opportunities for translation and collaborations with the NHS and industry.

Imperial's translation expertise along with strengths in medical research, physical sciences and engineering will all contribute to realising the Crick's vision.

King's College London

King's College London is one of the top universities in the world, with an outstanding reputation for providing world-class teaching and cutting-edge research. It is the largest centre for the education of healthcare professionals in Europe.

King's is renowned for its wide-ranging research and has played a major role in many of the advances that have shaped modern life, such as the discovery of the structure of DNA. More recently, scientists at King's developed the first computer programme to detect the early signs of Alzheimer's disease, and pioneered a new method of diagnosing autism in adults. With particular strengths in biomedicine, dentistry, psychiatry and nursing, its ground-breaking research continues to contribute significantly to advances in biomedical science.

With an excellent track record in bringing scientists and clinicians from a wide range of disciplines together to translate research into innovative treatments quickly, especially through its Academic Health Sciences Centre, King's Health Partners, the College will play a key role in bringing the Crick's science strategy to life.

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Until construction of the Francis Crick Institute is complete, our team will be based at the following address:

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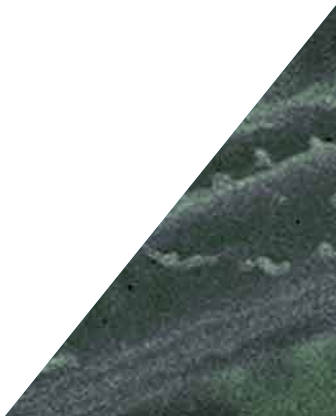

IMAGE CREDITS

Front cover: Scanning Electron Micrograph of a Skin Cancer Cell (false-coloured), by Anne Weston (CRUK LRI Electron Microscopy Core Technology Facility).

MRC Medical Research Council · UCL · Imperial College London · King's College London · wellcome trust · CANCER RESEARCH UK