UNIVERSITY OF TECHNOLOGY SYDNEY

SCIENCE
RESEARCH THEMES

UTS

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THINK.CHANGE.DO







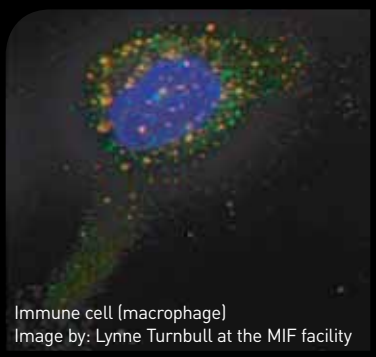
i3 ithreeinstitute
infection·immunity·innovation

ithreeinstitute.uts.edu.au

THE **ithree institute (i3)** BASED AT THE UNIVERSITY OF TECHNOLOGY SYDNEY (UTS) BRINGS TOGETHER AN INTERNATIONALLY COMPETITIVE TEAM FOCUSED ON ADDRESSING KEY CHALLENGES IN THE UNDERSTANDING AND CONTROL OF INFECTIOUS DISEASES IN HUMANS AND ANIMALS.

The institute consists of research groups led by renowned scientists in the field of microbial and parasitic infectious diseases. Its innovative science uses a systems biology approach to develop a greater insight into basic biology and its application to the diagnosis, treatment and prevention of infectious diseases.

An ithree Scientific Advisory Board chaired by Professor Jim Peacock, the ex Chief Scientist of Australia has been established to help steer the direction of the research at the institute.



Immune cell (macrophage)
Image by: Lynne Turnbull at the MIF facility

BENEFITS OF PARASITIC INFECTION

More than one third of the world's population is infected with pathogenic parasitic worms that cause cancer, anaemia and elephantiasis. At first sight, it may be difficult to see any possible benefit to humans from these parasite's fiendish life cycles and associated pathology. However, to promote their own survival, parasite worms regulate their hosts' immune response. It is thought that this ability may be of benefit in the control of excessive inflammatory reactions associated with many autoimmune diseases.

Due to these observations, the use of worm therapy to treat autoimmune diseases is increasingly being recognised and applied. Members of the ithree institute are working to identify the individual molecules secreted by parasite worms that are capable of regulating immune responses as these will be of significant therapeutic value. Characterisation of these molecules would also provide a clear means to decipher the mechanisms by which parasite worms exert their immune-modulatory effects.

OUR RESEARCH FOCUS: "ONE HEALTH"

Despite decades of groundbreaking research and the development of new medicines including vaccines and antibiotics, infectious diseases remain an important global animal and human health issue, posing a major problem to the wealth and wellbeing of nations. The ithree institute is at the forefront of understanding the importance of the interplay of pathogens in both human and animal hosts and the environment – the so called "One Health" model.

Our inter-disciplinary approach to basic and translational research to understand this "infectious ecology" will underpin the development of new solutions to infectious disease challenges that include:

- The changing geographical distribution of diseases due to economic migration, global mobility and the impact of climate change
- The emergence of new pathogens
- The threat to health from zoonosis
- An increasing number of antibiotic and drug resistant pathogens
- The potential threat to biosecurity including natural pandemics

The ithree institute has active research programs and collaborations in the fields of bacteriology, parasitology and virology. These programs include investigations into the pathogenic mechanisms across a spectrum of important infectious organisms, including for example *Pseudomonas aeuginosa* and *Staphylococcus aureus*.

Our research aims to increase our scientific understanding as well as to apply this to drug discovery and other areas of innovation.

The ithree institute occupies new state-of-the-art laboratories in central Sydney, including facilities for pathogen culture.

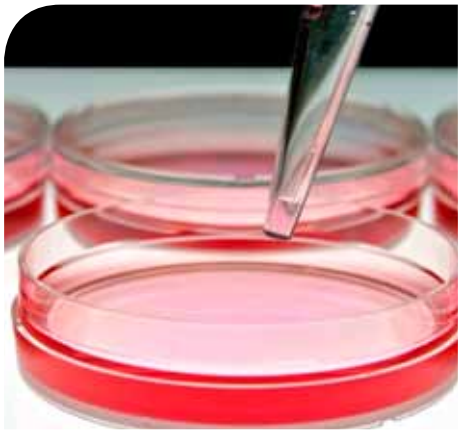
UTS has invested in a world-class **Microbial Imaging Facility** (MIF) that provides OMX super resolution imagery. Using these facilities we are able to observe for the first time high resolution images of living cells as they are invaded by a pathogen. These facilities, unique in the Southern Hemisphere, are available for both collaborative and contract research.

OMX Super Resolution Microscopy

Alongside the investment in the imaging, UTS has made a substantial commitment to create a dedicated **proteomics suite**, including cutting edge Mass Spectrometry, that enables high resolution mapping of proteins and other components on the surface of infectious organisms. The institute uses these facilities to explore the mechanism by which organisms become pathogenic.

These studies enable our scientists to make fundamental discoveries to identify new targets for the development of drugs, vaccines and diagnostics.

The past decades have seen an explosion in genomic knowledge that provides new insights into pathogenic behaviour and evolution. The ithree institute is using this knowledge to further explore the molecular processes of pathogenicity as well as the transference of genes. Gene transfer in bacteria is particularly important in understanding how antibiotic resistance is spread.



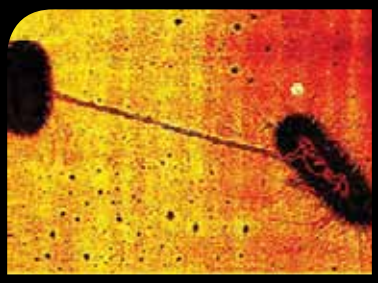


Image of two bacteria. One is donating DNA to another via conjugation, an example of the process of LGT.

BACTERIA SHARE THEIR GENES

Work at ithree has found that bacteria rapidly adapt by sharing genes in all environments. This sharing is made possible by the ability of different individuals, frequently involving individuals of different species, to donate and accept genetic material by Lateral Gene Transfer (LGT). LGT does not occur in animals or plants. However, in bacteria the process is very common allowing disparate bacteria to adapt to almost any environment at an extraordinary pace. The genes within this mobile DNA population are highly complex.

They allow bacteria to adapt to strange environments that are both good and bad from a human perspective. In infected wounds they can rapidly assemble combinations of antibiotic resistance genes that make treatment impossible and in coral mucus they can create complex communities of bacteria that help make coral healthy and resist attack from predators. At ithree, researchers are investigating LGT from all perspectives aiming to prevent infectious disease and discover new compounds for use in biotechnology.

The institute is affiliated with the Ramaciotti genomics institute, which provides access to **next generation sequencing and array technologies**. In addition the institute has established links to high throughput genome sequencing facilities in the UK and China, enabling it to accelerate its research in line with rapidly advancing technologies.

EXPERTISE

The institute has core expertise in molecular biology, cell biology, biochemistry, genetics, genomics, proteomics, bioinformatics and protein chemistry. In addition, it has specific skills in the following areas:

- Wide range of molecular techniques for analysing DNA, RNA and proteins
- Transcriptomics and proteomics
- Microarray technology and methods for analysis, such as clustering, gene set enrichment
- Analyses of genome data
- Recombinant protein expression
- Flow cytometry
- Protein-lipid biology
- Protease biology
- Mass spectrometry-based proteomics
- Bacterial cell division
- Next generation cell imaging
- Viral-host interactions
- Immunology and cytokine biology
- High resolution subcellular imaging
- Drug discovery
- Animal models of disease
- Molecular phylogeny
- Microbial ecology
- Expression of parasite proteins in prokaryotic expression systems
- In vitro culture of parasitic protozoa
- Vaccine technology for livestock (adjuvants, live and killed vaccine formulations)
- Evolution of antibiotic resistance
- Bacterial biofilm formations

COMMERCIALISATION

The ithree institute aims to facilitate high value partnerships between external organisations and its researchers by setting up research agreements which provide innovative, flexible and effective solutions to commercially or socially important problems. These partnerships can last anywhere from six months to five years or more, and deliver specific value to the funding partner.

In addition, the ithree institute is focused on ensuring that the output of its own innovative research makes an impact on human and animal health, through successful commercialisation. During 2011, the ithree institute was pleased to become a member of the Medical Research Commercialisation Fund (MRCF).

PARTNERSHIP

The core philosophy at the ithree institute is to work in partnership with others to deliver world-class scientific discovery and to drive innovation. We have established relationships with universities, research institutes, medical centres and industry, both within Australia and internationally. We welcome the opportunity to explore research collaborations, partnerships, licensing and spin-outs to work together to meet the 21st century challenges in infectious disease.

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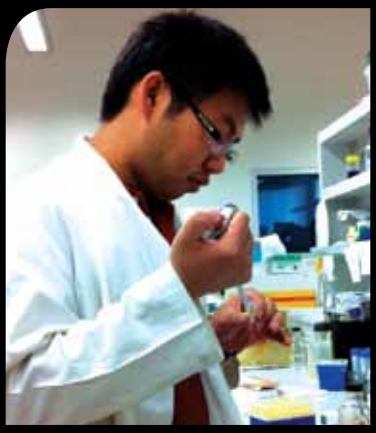
JOEL BARRATT

Joel Barratt has been a member of the ithree institute since 2007 where he studies a PhD in parasitic diseases. During this time he completed a first class honours degree on the epidemiology of neosporosis; he was subsequently employed as a research assistant on an ARC linkage project with St. Vincents Hospital where he made a major impact on methods for diagnosis of parasitic diseases.

In his PhD, Joel is studying the importance of *Dientameoba fragilis* as an emerging pathogen and is currently in his final year of studies. Since 2007, he has presented his research regularly at national and international conferences and workshops, such as the International Congress of Parasitology in 2010. Joel has also published 16 peer reviewed journal papers since 2007 which is a considerable accomplishment for a PhD student.



ANDREW LIEW

Andrew Liew is a PhD student at ithree who has developed a genetic system to induce expression of genes in *Staphylococcus aureus*, enabling them to be switched off completely, and then switched on to varying degrees. This allows researchers to test the function of any essential gene by turning them on transiently rather than permanently so that they don't kill the cell. Various assays can then be performed to identify the function of the gene. Essential genes with known functions can then be identified for their suitability as antibiotic targets.

Andrew has also used this system to label proteins with fluorescent tags to enable their localisation inside these tiny cells using super resolution microscopy. He has obtained 3-D images of these cells with unprecedented resolution. His innovative work has been awarded with a University Medal (2009) and the Burnet-Hayes Postgraduate Travel Award from the Australian Society of Microbiology. He travelled to the UK to present his research at the 2011 Society for General Microbiology conference in York, and performed research in Professor Simon Foster's laboratory at Sheffield University.

POSTGRADUATE RESEARCH DEGREES

UTS: Science is committed to spearheading innovation through degree programs that are strongly linked to industry, the scientific community and the population. All research degrees have a 100% research component aimed at producing a thesis that contributes new knowledge to the field of research.

HOW TO APPLY?

For information and a step by step guide to apply for a research degree at UTS: Science please go to:
www.science.uts.edu.au/for/future/research.html

SUPERVISION

To find a suitable supervisor, go to:
http://datasearch2.uts.edu.au/ithreeinstitute/members/index.cfm

For further assistance you can contact the UTS Science Research & Development Officer on:
Phone: + 61 2 9514 2490
Email: science.research@uts.edu.au

FEES

Local applicants:
www.sau.uts.edu.au/fees/postgraduate/research.html
International applicants:
www.uts.edu.au/international/prospective/studying/fees/

SCHOLARSHIPS

UTS: Science offers generous competitive research and coursework scholarships attracting the best students to work with teams of world-class researchers. Information about UTS:Science scholarships can be found at **http://datasearch2.uts.edu.au/science/scholarships/index.cfm**

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- ithree institute (i3)
  www.ithreeinstitute.uts.edu.au
- The Plant Functional Biology and Climate Change Cluster (C3)
  www.c3.uts.edu.au
- Centre for Environmental Sustainability (cens)
  www.research.uts.edu.au/strengths/es/overview.html
- Centre for Forensic Science (CFS)
  www.forensics.uts.edu.au
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