ARC Centre of Excellence in
CONVERGENT
BIO-NANO SCIENCE
& TECHNOLOGY

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Signature Projects

Our CBNS Signature Projects draw on the capabilities of our expert researchers to solve the big questions in bio-nano research.

A MATERIAL SCIENTIST'S GUIDE TO THE CELL

Leaders: Dr Angus Johnston, Professor Rob Parton

Co-Leaders: Dr Nik Veldhuis, Mrs Laura Selby

THE PROJECT

Effective drug delivery depends on delivering drugs to the sites in the cell where they are therapeutically active - and nanoparticles are seen as effective strategy for the future. The aim of this signature project is to gain a fundamental understanding of how nanoparticles are trafficked in cells.

In particular, we are focusing on understanding how nanoparticles and their cargo are internalised, trafficked in the endosomes and trafficked from the endosome into the cytoplasm (i.e. endosomal escape). These fundamental interactions are poorly understood and by understanding these interactions, we aim to engineer the next generation of nanoparticles that can respond intelligently to the cellular environment.

THE BIG QUESTION

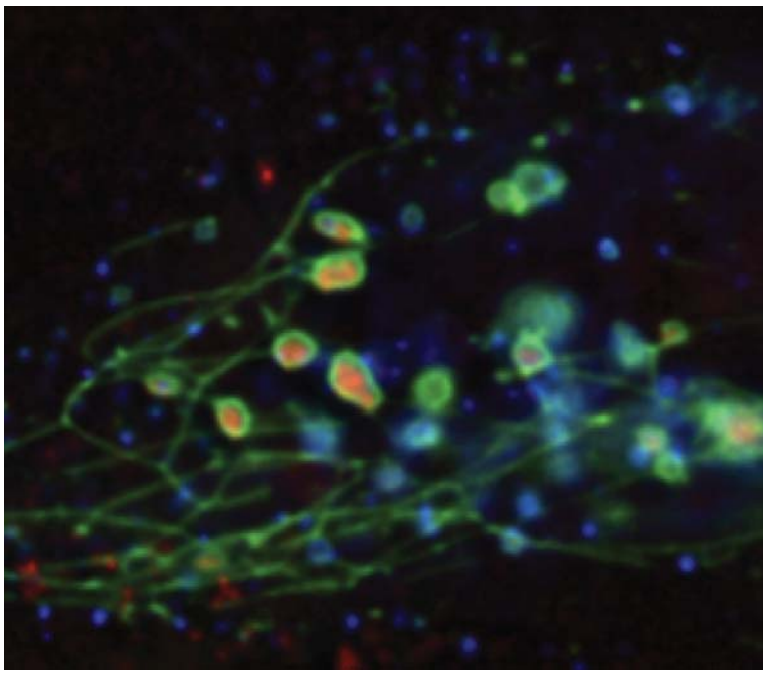
Can we improve the effectiveness of drugs by controlling where they are trafficked in cells?

The benefits of this research

- Improved therapeutic efficiency and lower side effects from drugs.

Our goals

- Engineer nanoparticles to target subcellular locations.
- Develop techniques to quantify cellular localisation in live cells.
- Translate our fundamental understanding of cellular processing to virtual reality visualisations.



Nanoparticles delivering their cargo into lysomes.

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Media highlights

- Virtual Reality Cancer; Today Tonight Channel Seven; 2017.
- Medical Wonders Scope; Channel Eleven; 2016.
- Journey to the centre of the cell; Nanorods and Worms Wriggle Best Science Daily; 2016.

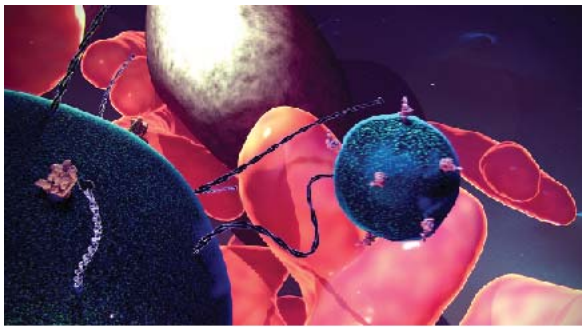
Electron Microscopy image of endosomes.

Recent publications

- Pair Correlation Microscopy Reveals the Role of Nanoparticle Shape in Intracellular Transport and Site of Drug Release. Nature Nanotechnology; 12, 81-89; 2017.
- Nanoescapology: Progress Toward Understanding the Endosomal Escape of Polymeric Nanoparticles; WIREs Nanomedicine and Nanobiotechnology; e1452; 2017.
- Life Under the Microscope: Quantifying Live Cell Interactions to Improve Nanoscale Drug Delivery; ACS Sensors; 2, 4–9; 2017.
- An Endosomal Tether Undergoes an Entropic Collapse to Bring Vesicles Together; Nature; 537, 107–111; 2016.

Signature Project collaborations: A material scientist's guide to the cell

Institution	Collaborator
University of New South Wales	Professor Justin Gooding
Columbia University	Professor Nigel Bunnett
University of Nottingham	Professor Cameron Alexander
Max Planck Institute Dresden	Professor Marino Zerial
National Centre for Biological Science Bangalore	Professor Satyajit Mayor
University of Melbourne	Dr Georgina Such



Vesicle being captured by filamentous EEA1 proteins.
Image: John McGhee, John Bailey, Andrew Lilja, 3D Visualisation Aesthetics Lab, UNSW (@3DVAL).

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