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School of Biomedical Sciences
Annual Report 2007

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Vicki Burkitt and Alexandra Roginski

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Technology Services Group – Multimedia Services

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Australia

Colony of human embryonic stem cells (light blue) growing on fibroblast feeder cells (dark blue).
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The School of Biomedical Sciences had many successes in 2007 in both education and research. Our 700 research staff and higher degree students work alongside approximately 1,000 undergraduate students, who represent scientists of the future and join the School through Biomedical Science and Radiation Sciences courses, as well as the Medical and Science degrees.

The influential *Times Higher Education Supplement* last year ranked Monash University 22nd in the world for Life Sciences and Biomedicine.

The School of Biomedical Sciences received approximately $57 million of funding from NHMRC, ARC and other Commonwealth funding sources for research in the fields of cancer, cardiovascular health, immunology, obesity, pharmacology, radiation sciences and stem cells. Overall, the School’s research income comprises half of all NHMRC funds awarded to Monash University. The School also published 425 papers in 2007.

A group of structural biologists led by Professor James Whisstock received one of the largest NHMRC program grants ever awarded to an all-Monash team – $11 million to study the role of proteases in various diseases.

Professor Jamie Rossjohn, an Australian Research Council Federation Fellow, received the Gottschalk Medal, the highest honour from the Australian Academy of Science for a researcher under 40 years of age.

IVF and stem-cell pioneer Professor Alan Trounson made international headlines in September when he was announced as the new President of the California Institute for Regenerative Medicine, one of the most senior stem cell appointments in the world.

Neuroscientist Dr James Bourne won an NHMRC Career Excellence Award, which recognises his pioneering work on the visual functions of the developing brain. The NHMRC ranked Dr Bourne as the top research applicant in the Career Development Awards.

The School continues to make international connections that enrich research and culture. Monash Immunology and Stem Cell Laboratories forged collaborative links with Peking University to form the Australia-China Centre of Excellence in Stem Cell Research. The School also hosted a visit from renowned biochemist Professor Elizabeth Blackburn.

In January, Professor Iain Clarke assumed the challenging role as Head of Physiology, replacing Professor Warwick Anderson, CEO of the NHMRC. Professor Clark is an eminent neuroendocrinologist, who is focusing his efforts in the developing field of ‘diabesity’ research, which links obesity with Type 2 diabetes.
Leading the fight against the Buruli (Bairnsdale) Ulcer
An international team of researchers led by Dr Tim Stinear unlocked the inner secrets of the Buruli (Bairnsdale) ulcer, a bacterial disease affecting thousands of people (predominantly children) each year throughout West and Central Africa and emerging in Victoria, with several serious outbreaks occurring in the past ten years in coastal towns near Melbourne.

The team was the first to complete the DNA sequence (genome) of the flesh-eating bacterium called *Mycobacterium ulceran*. It now has its complete blueprint and is being used to identify gene targets for improved diagnostic testing, and candidate drugs and vaccines.

The disease begins as an infection beneath the skin where an unusual toxin destroys fat cells and suppresses the immune system. Advanced stages result in massive skin ulcers, causing deformities and permanent disability. Victims often need extensive surgery to remove ulcers and repair skin defects. Antibiotics are not always effective and there is no vaccine.

Trailblazing scientist visits Monash
Internationally renowned biochemist Professor Elizabeth Blackburn spent three weeks at the School of Biomedical Sciences as the Louis Matheson Distinguished Visiting Professor.

Professor Blackburn solidified her reputation by discovering telomerase, an enzyme in chromosomes that adds a specific sequence of DNA to the telomeres (chromosome caps) after they divide.

*Time Magazine* recognised her last year as one of the 100 most influential people in the world, and she served on the US President’s Council on bioethics between 2001 and 2004. In 2006, she won the Albert Lasker Award for Basic Medical Research, which is considered the precursor to the Nobel Prize.

New direction for Multiple Sclerosis research
Professor Claude Bernard received a $500,000 competitive grant from the MS Society, USA, to fund groundbreaking new research.

His group aims to reverse the effects of MS-like diseases through stem cell-based therapies and manipulation of the thymus – an organ that plays a pivotal role in controlling immune responses.

Professor Bernard and his colleagues also found that an MS-like condition in mice can be significantly suppressed by either inhibiting molecules known to cause inflammation, or by blocking a protein that normally prevents nerves from regenerating.

He collaborates with Professor Richard Boyd, Professor Ban-Hock Toh, Dr Frank Alderuccio and Dr Ann Chidgey.

BHP Billiton camp
The School of Biomedical Sciences hosted 16 students who attended the 2007 BHP Billiton Science Awards Finalists’ Science Camp. The BHP Billiton Science Awards, a partnership between BHP Billiton and CSIRO, rewards young people who undertake research projects that demonstrate innovative approaches and thorough scientific procedures. Students toured the Monash Anatomy museum and viewed cadaver specimens.
Research breakthroughs in movement disorders and mental illness

A Monash research team led by Professor James Whisstock and Associate Professor Merrill Rowley solved the structure of two key proteins that control human movement and neural transmission.

In a paper published in the April edition of *Nature Structural and Molecular Biology*, the biologists revealed the three-dimensional structure of both forms of the neural enzyme glutamic acid decarboxylase (GAD). GAD produces a crucial neurotransmitter called GABA, which controls neuronal signalling, movement and tissue development.

The research explains how the two forms of the GAD function together to control GABA levels. Low concentrations of GAD and GABA may contribute to mental illnesses such as schizophrenia and movement disorders such as cerebral palsy.

The research, funded primarily by the NHMRC, is the result of 20 years of GAD-related research at Monash.

Two awards for leading biochemist

Professor Jamie Rossjohn, whose research in biomedical sciences includes insights into how killer T-cells recognise viruses, received the prestigious 2007 Gottschalk Medal in May.

The Gottschalk medal is presented by the Australian Academy of Science to a researcher less than 40 years of age for their outstanding contribution to medical sciences.

Professor Rossjohn also received the Commonwealth Health Minister’s Award for Excellence in Health and Medical Research. This prize is awarded each year during Medical Research Week to an outstanding scientist, who is an inspiring role model and mentor, and skilled health communicator.

Professor Rossjohn’s research program aims to address how pathogenic bacteria cause disease, central questions relating to immunity, and finding new treatments to combat diseases. He is also an Australian Research Council Federation Fellow.

Second life for immune response

Professor Richard Boyd identified a group of cells that help to rebuild the immune system following chemotherapy. Professor Boyd and Dr Daniel Gray found that mesenchymal cells restore a damaged thymus by supporting the growth of surrounding cells, a discovery published in *The Journal of Immunology*.

The thymus is a major engine room of the immune system and produces specialised white blood cells called T-lymphocytes, which destroy viruses, cancer cells and cells of transplanted organs.

Chemotherapy severely depletes the immune system and injures the thymus, which affects a cancer patient’s recovery rate and level of immunity. The thymus recovers in children, but rarely in adults, and compromises their ability to fight infections and ward off cancer.

Premier’s award for medical research

PhD student Fleur Tynan received a commendation in the Premier’s Award for Medical Research, which is announced each year during Medical Research Week. This accolade recognises the contribution of young medical researchers and is an initiative of the Victorian government and Australian Society for Medical Research. The judges recognised Fleur’s work in the field of X-ray crystallography, where she studied how T-cell receptors recognise Major Histocompatibility Complex molecules on the surface of infected cells. Both proteins play a key role in the human immune system.

Immune system’s fat problem solved

Monash and Melbourne University scientists unlocked a 15-year mystery and advanced understanding of how the human immune system fights disease. The findings, published in *Nature*, could lead to treatments that help the body respond to harmful microbes and cancer cells.

The team of researchers discovered how T-cell receptors recognise fats called glycolipids – which are found in bacteria and cancer cells – and initiate an immune response.

The interaction was unravelled by Dr Natalie Borg, Kwok Soon Wun and Professor Jamie Rossjohn, and researchers from the University of Melbourne.
Monash University home to largest monoclonal antibody facility in the southern hemisphere

The Monash Antibody Technologies Facility (MATF) set up for business at the Clayton campus.

When fully established, the high-tech robots at MATF will store and produce up to 100 million monoclonal antibodies for use in medical research.

“The capacity is so large that for the first few years there will be no access problems for interested scientists to access our services,” said MATF Director Alan Sawyer, a recruit from the prestigious European Molecular Biology Laboratory. “After that, if we reach capacity, we will probably expand.”

Award from the heart for blood pressure research

The National Heart Foundation (NHF) awarded its prestigious John Shaw Award to Research Fellow Dr James Armitage. This accolade recognises his work on high blood pressure in obese people, and is awarded to the highest ranked NHF postdoctoral fellow in Australia.

Dr Armitage also researches how fat, essential fatty acid, protein and micronutrient levels during pregnancy and early postnatal life can program for cardiovascular disease and obesity in offspring.

Toxic shock: immune system’s anthrax link

Professor James Whisstock and Dr Michelle Dunstone led a team that found that human immune proteins, which fight cancer, viruses and bacterial infections, belong to an ancient and lethal toxin family previously only found in bacteria.

This perforin-like protein punches holes into bacteria, virally-infected cells and cancer cells, and kills them. This disease-fighting molecule is also related to deadly bacterial toxins that cause anthrax, gas gangrene and scarlet fever.

Professor Whisstock, winner of the 2006 Science Minister’s Prize for Life Scientist of the Year, initially was stunned when it became clear that the bacterial toxins and perforins had a common ancestor, and said that people who lack the perforins can develop a serious blood disorder called hemophagocytic lymphohistiocytosis, and may be predisposed to develop cancer.

The Monash researchers collaborated with scientists from the NHMRC’s protease systems biology program, the ARC’s Centre of Excellence in Structural and Functional Microbial Genomics, and the Peter MacCallum Cancer Centre. The group published the three-dimensional structure of a perforin-like protein in the prestigious journal Science.

SOBS researchers win prestigious NHMRC awards

Two Monash researchers won prestigious NHMRC awards in December.

Neuroscientist Dr James Bourne won a Career Excellence Award for his work on the visual cortex of the brain following trauma. He was selected as the most outstanding early-career research scientist from a field of around 400 applicants.

Renowned malaria researcher Associate Professor Brian Cooke snared the Science to Art award for his microscopic image depicting the alterations that the malarial parasite affects on the human red blood cell.

The NHMRC handed out 16 awards to Australian scientists – the highest honour at a national level – recognising scientific and leadership excellence in health and medical research.

Neuroscientists connect hemispheres

Monash brain experts hooked up with the University of Newcastle’s Institute of Neuroscientists for a meeting in July to forge strategic partnerships.

The three-day Connecting the Hemispheres Conference was organised by Dr James Bourne and Professor Ian Smith, and brought together 26 researchers from each research group to discuss areas of common and complementary research.
New grant for protease research
A team of Monash biochemists received an $11 million program grant from the NHMRC to develop new treatments for high blood pressure, heart disease and stroke.

The program’s chief investigators, James Whisstock, Ian Smith, Philip Bird, Stephen Bottomley, Rob Pike and Ashley Buckle research the role of proteases in diverse diseases such as cancer, heart disease and dementia.

The team also want to understand how the human immune system fights bacterial and viral infection.

National Forum on Education in Biomedical Sciences
The School of Biomedical Sciences took a leadership role in undergraduate education, convening a forum to address teaching issues specific to this field of science and technology.

Associate Professor Trevor Anderson from the University of KwaZulu-Natal in South Africa delivered the keynote lecture on conceptual learning in biomedical sciences. He discussed the common pitfalls that students face when trying to understand diagrams and other learning aids. Other presentations covered topics including: problem-based learning, graduate attributes, communications and laboratory skills, and the contribution of new multimedia technologies to education.

Professor Anderson also joined the School of Biomedical Sciences for ten days as Scholar in Residence.

Inaugural Kay Patterson award
Doctoral candidate Anne Fletcher won the inaugural Kay Patterson Award for Research Excellence for her work identifying cells that could stop donor tissue rejection in transplant patients.

The final-year PhD student at the Monash Immunology and Stem Cell Laboratories worked with T-cells – the gate-keepers of human immunity. She discovered a stem cell that turns into the ‘Thymic Epithelial Cell’ (TEC) group, and teaches T-cells the difference between a person’s own tissue and foreign material. She believes that if these stem cells were collected from an organ donor and transplanted with their tissue into the recipient patient, their T-cells might accept the donor organ as its own.

The Kay Patterson Award is given to an outstanding postgraduate student at MISCL. It is named in honour of former Federal Senator Kay Patterson, who has been a champion of stem cell legislation.

Weight loss therapies get warmer
Monash scientists Dr Belinda Henry and Professor Iain Clarke, together with Professor Frank Dunshea from the University of Melbourne, found that leptin – a fat-derived hormone – acts on the brain to increase heat production in both muscle and fat, and therefore food metabolism.

This result is significant as muscle makes up more than one third of the body mass, and a leptin-like molecule could possibly trick the body to lose weight by turning up this internal heat dial.

The findings, which were published in the December edition of Endocrinology, could lead to new long-term treatments for weight loss, which burn energy in the body rather than control food intake.

Stem cell links go international
Delegates from the Monash Immunology and Stem Cell Laboratories travelled to Beijing in November for the official signing ceremony of the Australia-China Centre for Excellence in Stem Cell Research.

Worth nearly $2 million, the Centre pools people, knowledge and scientific technologies of Peking and Monash Universities, accelerating stem cell research and opening up new commercial opportunities.

The collaboration is the brainchild of former MISCL director Professor Alan Trounson and Professor Lingsong-Li, who heads the prestigious Peking University Stem Cell Research Centre, which was selected in 2006 as China’s home of regenerative medicine.

Almost half of the Australia-China Centre’s money comes from the Federal Government’s Australia-China Special Fund for Scientific and Technological Cooperation.
Research in the School of Biomedical Sciences is conducted within seven departments:

- **Anatomy and Developmental Biology**
  Head, Professor John Bertram

- **Biochemistry and Molecular Biology**
  Head, Associate Professor Rob Pike

- **Medical Imaging and Radiation Sciences**
  Head, Associate Professor Marilyn Baird

- **Microbiology**
  Head, Professor John Davies

- **Monash Immunology and Stem Cell Laboratories**
  Acting Head, Professor Richard Boyd

- **Pharmacology**
  Head, Professor Harald Schmidt

- **Physiology**
  Head, Professor Iain Clarke

Research in this report is organised into the following areas:

- Cancer
- Cardiovascular Disease
- Developmental Biology
- Diabetes
- Fetal and Baby Health
- Immunology and Stem Cells
- Infectious Diseases
- Medical Imaging and Radiation Sciences
- Neuroscience
- Pharmacology and Drug Design
- Structural Biology
This laboratory investigates proteins from viruses that cause AIDS and Dengue fever, as well as molecules that modulate cancer or development.

Our research examines how protein molecules of medical relevance move in and out of the control centre of the cell, the cell nucleus. Additionally, we can potentially better target therapeutic molecules to the nucleus of cells to combat cancer, or correct genetic defects.

In 2007, we found that the cellular cytoskeleton facilitates the transport of specific proteins to the cell nucleus, which regulate cancer and/or viral proteins.

NHMRC Senior Principal Research Fellowship
- (2006-2010)

ARC Centre of Excellence for Biotechnology and Development Grant
- From genes to germ cells to sperm (2003-2011).

NHMRC Project Grants

Our candidate anti-cancer drug is an antibody that recognises a protein on the surface of cancer cells and regulates their positioning in the body.

NHMRC Project Grant
- The role of protein tyrosine phosphatases regulating Eph RTK-signalling and modulating invasive tumour cell properties (2007-2009).

KaloBios Pharmaceuticals Inc. Translational Research and In-licensing Agreement

NHMRC Equipment Grant

Awards and achievements
A provisional US Patent Application # 60903848 was submitted on 8 March for EphA3 antibodies for the treatment of solid tumours.

A therapeutic antibody (red), marking cancer cells (blue) and tumour blood vessels (green) in a prostate tumour.
Cancer

Plasma Membrane Electron Transport, Iron Uptake and Apoptosis

Dr Alfons Lawen

Iron is important for cellular survival: without iron, every cell will die. In its physiological form, extracellular iron is complexed by chelators, molecules that bind to metallic ions.

The most important chelators are the protein transferrin and the metabolite citrate. In order for iron citrate to be taken up by a cell, iron has to be first reduced from iron (III) to iron (II).

For this reduction to occur, the electrons must be supplied from inside the cell. Our interest lies in understanding how cells transport electrons across the plasma membrane.

We have analysed the cellular uptake of iron from iron citrate in detail, and found that vitamin C (ascorbate) is needed to both reduce iron and take it up. Cells actively export vitamin C for this purpose and take up oxidised vitamin C (dehydroascorbic acid). The cells then recycle it back to vitamin C and release it for further iron reduction (see figure). In this way, vitamin C from the cells supplies electrons for this reaction and the subsequent uptake of iron.

www.med.monash.edu.au/biochem/staff/lawen.html

Intracellular Signalling and Cancer

Professor Christina Mitchell

Head, School of Biomedical Sciences

Our major focus is to identify and study novel genes and proteins that regulate cell proliferation and death, cell migration and invasion.

We work on lipid phosphatases and adaptor proteins, which hinder signalling in the phosphoinositide 3-kinase pathway. We study lipid phosphatases that are either expressed in high or low levels in tumours including breast, prostate and cervical cancer.

Our team also investigates how these lipid phosphatases regulate cancer cell growth, proliferation and/or cell death. Cell motility and invasion are tightly regulated to prevent the spread or metastasis of cancer cells from one tissue to another. We are currently investigating how lipid phosphatases regulate cancer metastasis.

Our group also study the role of the Four and a Half LIM (FHL) family proteins in skeletal and cardiac muscle function. Mutations in these proteins cause muscle disease in humans.

NHMRC Project Grants

• The role of PIPP in cell polarisation and proliferation (2007-2009).


Research Fellows

Dr Lisa Ooms
Dr Ann Kong
Dr Ragendra Gurung
Dr Jennifer Dyson
Dr Megan McGrath
Dr JoAnne Waters
Dr Ivan Ivetac
Dr Kristy Horan
Dr Denny Cottee
Dr Absorn Sriratana

PhD Students

Ms Belinda Cowling
Ms Megan Astle
Ms Monica Naughton
Ms Gillian Stetson
Mr Denis Balamatsias
Ms Pasivin Rahman
Ms Michele Davies
Ms Clare Fedele
Ms Lauren Binge
Dr David Sheffield
Ms Dianne Strong
Ms Dharini Kethespan
Mr Jordan Kane.

Masters Student

Ms Chayanica Nasa

Intracellular Signalling and Cancer

HeLa cervical cancer cells stained for polymerised tubulin (green) and the nucleus (red)

HeLa cervical cancer cells stained for polymerised tubulin (green) and the nucleus (red)


HeLa cervical cancer cells stained for polymerised tubulin (green) and the nucleus (red)

HeLa cervical cancer cells stained for polymerised tubulin (green) and the nucleus (red)
We study how cells respond to different external stresses. We investigate the processes that determine whether cells survive or die under these stresses.

These processes are fundamental to our understanding of diseases including: neurodegenerative disorders, cancer and bacterial infectious diseases. This knowledge can be used to develop strategies to prevent or treat diseases.

In 2007, we focused on nerve cells, which either live or die depending on whether a programmed cell death pathway is switched on or off.

We studied how stresses affect death responses in cell culture models of disease: primary cortical neurons which mirror what happens in the acutely damaged brain after stroke, motor neurone-disease like cells following protein aggregation, and how heat shock proteins protect neuroblastoma cells.

We collaborated with Professors Phil Beart and Mal Horne from the Howard Florey Institute and Professor Robin Anderson at the Peter MacCallum Institute for Cancer Research.

Together with the ARC Centre of Excellence on Structural and Functional Microbial Genomics, we studied the role of host-pathogen interactions in bacterial infections, which includes the Toll-like receptors and macrophage responses following mycobacteria infection. We collaborated with Monash Professors John Davies and Ross Coppel, and Dr Ashley Mansell from Monash Institute of Medical Research.

NHMRC Program Grant

ARC Centre of Excellence

Human neuroblastoma cells after treatment leading to the death of some cells. Healthy cells (top left and centre of the image) display clear distinction between the red colour of cytochrome c (a component of mitochondria) and the blue colour of the nucleus.

The rounded single nucleus in each of these two cells indicates the normal healthy situation. By contrast, the other four cells all have fragmented nuclei (blue dots), indicating that these cells are well on the way to cell death (apoptosis).

Here, the red cytochrome c stain may be dispersed (indicating its release from mitochondria, upper right cell) or may be still in particles (indicating retention in mitochondria, bottom right cell).

www.med.monash.edu.au/biochem/staff/nagley.html
Cancer Biology and Metastasis Laboratory

The major cause of death among cancer patients is the spread of cancer from its primary site of growth to distant organs – a process known as metastasis. We hope to increase our understanding of metastasis and identify novel agents that can be used in cancer therapy.

Currently, there are no effective treatments to combat cancer spread. To better understand this process, we performed gene array analysis on cancer cells that either have a high or low propensity to metastasise. Through this work, we identified genes that play a role in this process and may constitute novel therapeutic targets. We also identified a 'stress related' gene signature that can identify cancer patients who are more likely to develop metastasis. Some of these signature genes are controlled by a molecule called HSF-1, which plays an important role in cell migration, growth and survival. We are trying to inhibit this molecule in cancer cells to determine if this is a viable anti-metastatic treatment approach.

We are also testing the efficacy of EGCG as an inhibitor of bone metastasis. We have previously shown that this antioxidant molecule in green tea can inhibit breast cancer growth, survival and cell migration. EGCG also prevents the formation of osteoclasts, cells that break down bone and help form bone metastases. Future studies will confirm if this natural compound is an effective preventative treatment for bone metastasis.

NHMRC Project Grant

Cellular Signalling and Human Disease

Our laboratory focuses on the role of cell communication networks, or cellular signalling, in physiological and pathological processes such as diabetes and cancer.

We study protein tyrosine phosphorylation, which is regulated by two families of enzymes: protein tyrosine kinases (PTKs) and protein tyrosine phosphatases (PTPs).

The laboratory is interested in deciphering how these enzyme families control signalling pathways that are important in glucose regulation, T-cell mediated immunity and cancer development. A specific focus of the lab is to explain how increased PTK signalling may affect cellular division and contribute to cancer.

NHMRC Senior Research Fellow
• (2006-2010)
The group investigates the basic mechanisms that regulate function of the kidney, heart and vascular system.

We aim to determine the causes of hypertension, heart failure and kidney disease. We do this both by studying the normal function of the cardiovascular system and the causes and consequences of its dysfunction in disease.

We use a range of techniques that allow us to visualise the cardiovascular system and study its function at all levels, from interactions between specific molecules to the integrated organism.

We recently made significant contributions to our understanding of cardiovascular disease. We:

- Showed some of the mechanisms by which a poor developmental environment can lead to high blood pressure and cardiovascular disease.
- Showed how nerves in the kidney contribute to the development of some forms of high blood pressure but not others.
- Identified some of the factors that make the blood pressure of certain individuals sensitive to high salt intake.
- Showed that the various factors released from the vascular endothelium have varied roles in the body and in different species. These important mechanisms are also differentially affected in diabetes.
- Discovered a new mechanism of oxygen regulation in the kidney.
- Demonstrated how heart muscle function is disrupted in heart failure at the molecular level.
- Showed that the hormone angiotensin II has different effects on blood pressure in females and males.
- Demonstrated the protective effect of the amino acid arginine in high blood pressure caused by angiotensin II.

NHMRC Senior Research Fellowships
- (2001-2010)

NHMRC CJ Martin Fellowship
- (2006-2009)

NHMRC Project Grants
- Exploring the physiological, morphological and molecular basis of renal developmental programming (2005-2008).

ARC Discovery Grants
- Engineering imaging and supercomputer prediction of biofluid flows (2008-2010).

National Heart Foundation of Australia (Grant-in-Aid)
- Neural control of kidney function in obesity-induced hypertension (2007-2008).

Monash Synchrotron Fellowship
- (2005-2007)

For other cardiovascular disease research see Pharmacology and Drug Design section, pages 40 – 45.
Our research centres on understanding how growth is regulated in the intestinal epithelium during embryonic development, adult life and the initial stages of tumour development.

The intestinal epithelium or bowel lining is a regenerative tissue that is constantly renewed throughout life via a small population of stem cells. We are interested in how the balance between cell proliferation, differentiation and death is normally established and maintained in these cells. Defects in the regulation of growth of intestinal epithelium can have dramatic consequences for human health, including the development of colorectal or bowel cancer. Colorectal cancer is very common in Australia and is responsible for many deaths each year.

The laboratory uses an innovative mouse intestinal organ culture system. Through this culture system, we can observe the behaviour of live cells, and examine the effects of specific growth factors and inhibitors. Organ culture is also used to investigate how potential cancer-causing genes disrupt the biology of epithelial cells. We do this by introducing gene expression constructs into the epithelial cell layer of intestinal explants and studying the consequences. Of particular interest are studies on the effects of mutation of the Adenomatous Polyposis Coli (APC) gene.

Mutations in APC are found in the early stages of around 80 per cent of sporadic human colorectal tumours. Our laboratory uses the organ culture system to study the precise biological effects of APC mutation on the behaviour of intestinal epithelial cells.

The laboratory also studies intestinal stem cells, which are responsible for the continuous renewal of the entire epithelium. The mechanisms and molecules that govern the rate of stem cell division are crucially important, as they regulate the number and balance of differentiated cell types in normal tissue. Molecules and signalling pathways that identify and regulate stem cell populations in the intestine are under investigation.

NHMRC Project Grants
• APC mutation and the initiation of colorectal cancer (2006-2008).
• The roles of β-catenin, APC and the Wnt/β-catenin pathway in lens development (2006-2008).

ANZ Charitable Trust
• Inducing colon cancer in organ culture (2007).

The intestinal epithelium is a monolayer of polarised cells that is constantly renewed throughout life via a population of stem cells. This image depicts the epithelium in the small intestine where the cell membranes of individual cells are outlined in green and nuclei in red.
We want to understand how the environments encountered during fetal and early postnatal life affect our metabolism and cardiovascular health as adults.

We use several experimental animal models to understand how maternal diet – particularly fat, protein, and micronutrients – can program cardiovascular disease and obesity in offspring. We use rabbits to study the manner by which maternal fat intake during pregnancy and suckling contributes to obesity-related hypertension in offspring, the role of the sympathetic nervous system in this process, and how specific signals in the brain affect stress responses.

We also study how short-term (three-week) fat consumption in otherwise healthy rabbits can change nerve signalling in the hypothalamus, alter sympathetic nervous system (SNS) activity and affect blood pressure. This will help us determine whether increased SNS activity leads to obesity-related hypertension.

National Heart Foundation Postdoctoral Research Fellowship


Awards and achievements

- John Shaw Award, National Heart Foundation
  - Dr James Armitage

Collaborators

- Associate Professor Geoffrey Head, Baker IDI Heart and Diabetes Research Institute
- Dr Bang Bui, University of Melbourne

We study how factors such as malnutrition, maternal alcohol consumption and vitamin D deficiency influence the growth of the baby whilst in the mother’s womb. We are also interested in determining how exposure to these factors in pregnancy influences the long-term health of the individual. We also investigate the effects of premature birth on the development of the heart and kidney, and the consequences to postnatal renal and cardiovascular health.

It is important to understand how these early developmental insults affect heart and kidney development, since the functional units of these organs (the cardiomyocytes and nephrons, respectively) are only formed in early development. A reduced complement of these functional units at birth is likely to adversely impact on cardiac and renal health.

NHMRC Project Grant


NHF Project Grant

Head, Department of Anatomy and Developmental Biology

We study fetal kidney development, the impact of suboptimal fetal kidney development on fetal and adult health, as well as kidney regeneration following injury.

Kidneys are vital for life. During fetal development, the forming kidney is vulnerable to the harmful effects of gene mutations and environmental factors such as diet, antibiotics and stress hormones.

As a result, the kidney may form with permanent structural and functional defects. On a positive note however, the adult kidney has a remarkable ability to regenerate. By understanding this process, we can develop new therapies for patients with inherited or acquired kidney disease.

In 2007, we worked on the following research projects:

- The effects of alcohol exposure during pregnancy on kidney development;
- The effects of a maternal, fat-rich diet on obesity and high blood pressure in offspring;
- The effects of a low protein diet on kidney development and the adult consequences for kidney function, pathology and blood pressure;
- The molecular mechanisms that lead to permanent kidney damage in offspring when mothers are exposed to a low protein diet during pregnancy;
- The molecular regulation of kidney and ureter development with a specific focus on members of the transforming growth factor-ß superfamily;
- The role of bone marrow-derived and resident kidney cells in kidney regeneration following injury;
- Nephron cell number and correlations (birth weight, age, gender, hypertension) in diverse human populations (Caucasians, Aboriginal Australians, African-Americans and Senegalese Africans); and
- The range and associations of glomerular volumes in the human kidney.

NHMRC Project Grant
- The effects of pre-term birth on the baboon and human neonatal kidney (2007-2009);

NHMRC Project Grant

NHMRC Equipment Grant
- IVIS200 Biophotonic Imaging Unit (2007).

Monash Faculty of Medicine, Nursing and Health Sciences Strategic Grant Scheme

Kidney Health Australia Seeding Grant
- The role of bone marrow-derived endothelial-myofibroblast-transdifferentiation in renal injury and regeneration in the mouse (2007).

Australian Kidney Foundation Bootle Bequest Grant

National Heart Foundation

Royal Australasian College of Physicians
- Study of Indomethacin and Ibuprofen on glomerular development in the fetal and newborn rat (2007).

National Institutes of Health (USA) NIDDK

Awards and achievements

NHMRC Peter Doherty Fellowship
- Dr Jinhua Li

Best Poster Prize
- Renal Disease in Minority Populations and Developing Nations meeting – Ms Bridgette McNamara

Keith Dixon Prize Australian Society of Cell and Developmental Biology
- Mr Ken Walker

Student Prize 34th Fetal and Neonatal Workshop
- Ms Reetu Singh

www.med.monash.edu.au/anatomy/research/kidneydevelopment.html
We are examining the nature of memory impairment in both Alzheimer's disease and prenatal hypoxic stress, and the cellular mechanism of memory enhancement in cell cultures of both astrocytes and neurones. Despite many years of research, we still do not know exactly what memory is, how it is formed, how it is held and how it is retrieved. We are currently examining factors that influence memory formation and result in memory storage. The laboratory studies the physiological and anatomical responses to early damage to the visual functions of the brain in non-human primates. Here, we touch upon one of neuroscience’s great puzzles: that early trauma to the brain results in less visual impairment than a similar injury in adulthood.

I hope that one day we will be able to switch on these developmental mechanisms after a stroke or other brain injury, and stimulate regeneration of vision. The result could be a new lease on sight for patients previously condemned to a life of impairment.

**NHMRC Project Grant**

**Awards and achievements**
- NHMRC Achievement Award for Excellence in Health and Medical Research  
  - Dr James Bourne

**We are examining the nature of memory impairment in both Alzheimer's disease and prenatal hypoxic stress, and the cellular mechanism of memory enhancement in cell cultures of both astrocytes and neurones.**

Despite many years of research, we still do not know exactly what memory is, how it is formed, how it is held and how it is retrieved. We are currently examining factors that influence memory formation and result in memory storage. We are looking at the role of the brain neurotransmitters and gliotransmitters (noradrenaline, ATP and D-serine) on memory processing in the hippocampus, cortex and locus coeruleus of the chick. The experiments involve a single trial task where young chickens learn that a bead of one colour has a bitter taste, but another colour has no taste. This simple task can be manipulated to produce either weak or strong memory. We are examining how stress hormones (corticosterone, catecholamines and the synthetic glucocorticoid dexamethasone) injected into chick embryos affect the chickens’ ability to form memories after hatching.

This year, we found that we could mimic the memory loss seen in Alzheimer's disease by injecting an amyloid protein into specific brain regions prior to training. We rescued the damaged memory with an adrenergic drug. Interestingly, this same drug rescued memory damaged by high levels of stress hormones in ovo.

I hope that one day we will be able to switch on these developmental mechanisms after a stroke or other brain injury, and stimulate regeneration of vision. The result could be a new lease on sight for patients previously condemned to a life of impairment.

**NHMRC Project Grant**

**Awards and achievements**
- NHMRC Achievement Award for Excellence in Health and Medical Research  
  - Dr James Bourne

**How do multiple areas of the visual cortex evolve? What connections form in the brain at an early age? How does the brain develop in such a seamless manner to communicate between individual areas?**

Much of the brain is devoted to vision, a mechanism that we take for granted but which demands the functional operation of many parts of the cerebral cortex. By examining the development and maturation of the non-human primate cortex following birth, I hope to discover how the brain adapts to recognise everyday objects and variables.

My work has challenged traditional hypotheses by examining whether alternate routes from the eyes to the brain assist with the formation of the multiple cortical areas during development.

The laboratory studies the physiological and anatomical responses to early damage to the visual functions of the brain in non-human primates. Here, we touch upon one of neuroscience’s great puzzles: that early trauma to the brain results in less visual impairment than a similar injury in adulthood.

I hope that one day we will be able to switch on these developmental mechanisms after a stroke or other brain injury, and stimulate regeneration of vision. The result could be a new lease on sight for patients previously condemned to a life of impairment.

**NHMRC Project Grant**

**Awards and achievements**
- NHMRC Achievement Award for Excellence in Health and Medical Research  
  - Dr James Bourne
Our overall goal is to understand how exposure to an adverse environment during prenatal and early postnatal development affects key organs, with the ultimate aim of improving health outcomes.

Respiratory illnesses are a major cause of death and disability. It is now known that the risk of respiratory illnesses such as asthma and chronic obstructive lung disease may be exacerbated by an adverse environment during fetal life and infancy. Factors that can cause persistent changes in lung structure and function include: fetal growth restriction (as a result of placental insufficiency, maternal malnutrition or smoking), premature birth, exposure to infections, ventilator-induced lung injury, and maternal alcohol consumption.

Our major research questions are:

1. **How does preterm birth alter lung development?**
   Premature birth affects eight to ten per cent of all infants and has long-term effects on health. Preterm infants are exposed to ventilation and high levels of oxygen, which can injure the lungs and alter lung structure permanently. Our research aims to understand how oxygen exposure after premature birth alters the development of the lungs, and how it can be prevented.

2. **How does the early environment alter lung development?**
   Impaired growth during early life causes permanent changes to lung function, but the process that occurs is unknown. We explore the molecular and cellular mechanisms that trigger structural changes in the airways and alveoli of the lung in underweight animals. In collaborative studies, we also study how impaired growth affects heart and kidney development.

3. **How does alcohol exposure affect fetal organ development?**
   Many children are exposed to alcohol before birth, but it is unclear how critical organs are affected. We are working collaboratively to understand how alcohol impacts the brain, kidneys, heart, vessels and lungs.

**NHMRC Senior Principal Research Fellowship**
- (2005-2009)

**NHMRC Grants**
- Novel strategies for improving respiratory support and outcomes for very preterm babies (2006-2010).
- Protecting the preterm fetal brain from hypoxia and infection: a healthy start to life (2005-2007).

**Canadian Institutes of Health Research**

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**Molecular Genetics**

We use genetically modified mice to study gene function. Our research focuses on two areas: abnormalities of Down syndrome, and ETS genes in development and cancer.

DSCR1 and ITSN1 (intersectin-1), are expressed in high levels in the developing Down syndrome brain and are thought to play a role in the release and/or uptake of neurotransmitters. Using mice that either over-express the gene (as a model of Down syndrome) or mice with the gene ‘turned off’, we study the functions of DSCR1 and ITSN1 in the brain to understand which genes contribute to specific brain changes associated with Down syndrome, including Alzheimer’s disease-like pathology.

ELF3 and ELF5 are transcription factors that are made by epithelial cells, the cell type that lines body structures. In mice with the gene ‘turned off’, we have shown that ELF3 is essential for the development of epithelial cells in the small intestine.

Likewise, ELF5 is needed for pregnancy-associated mammary gland development. We study the roles played by ELF3 and 5 in the normal development and function of epithelial cells, and whether they contribute to diseases such as cancer.

**NHMRC Project Grant**

**ANZ Trustees – The Mason Foundation**
- The role of DSCR1 in Down syndrome and Alzheimer’s disease (2007).

**APEX Foundation for Research into Intellectual Disability**
- The role of DSCR1 in Down syndrome and Alzheimer’s disease (2007).

**Windermere Foundation**

**L.E.W. Carty Charitable Fund**
Our laboratory studies the biochemical and developmental basis of skin disease. Our primary research focus is to understand the role of the large, extra-cellular proteins of the Fras and Frem family in controlling the development and adhesion of the skin. Mutations in these genes cause a severe and often fatal human blistering disease called Fraser Syndrome.

The Fras and Frem proteins act as adhesion molecules, ensuring that the developing skin remains attached to the body. They also play a crucial role in the development and maintenance of the kidney.

We are exploring the interaction of these proteins with growth factors which regulate embryonic development. We have developed a software package which models and analyses defects in early kidney development in animal models of kidney disease.

In collaborative studies with the Walter and Eliza Hall and Baker Institutes, we have characterised an animal model of one of the congenital ichthyoses – a disease where the formation of the skin's protective waterproofing barrier fails and its cells fail to shed from the skin surface. This model will allow us to understand how the skin develops and maintains its important protective function.

We also study the role of a protein modification called palmitoylation, which is required for the development of hair follicles and sebaceous glands, and appears to control stem cell activity in the skin. Through links with mouse mutagenesis projects worldwide, we are analysing new and exciting models of skin and hair disorders, which will provide valuable insights into the development of our largest organ.
The Beta Cell laboratory is working to find new ways to treat and prevent diabetes.

Diabetes is a disease of the pancreas, where insulin is not produced and/or the body cannot respond to this hormone. This results in high sugar levels in the blood.

The Beta Cell Laboratory discovered a family of small peptides that improve insulin function and are studying how these peptides work, where they come from and how they can be used to treat diabetes.

During 2007, our laboratory in partnership with Dia-B Tech Ltd, a local biotechnology company, successfully completed a Phase I clinical trial on a candidate peptide called ISF402. This molecule is safe in humans, and work can now proceed to develop ISF402 further as a treatment for Type 2 diabetes.

In Type 1 diabetes, beta cells are destroyed by the body's own immune system. We have found a class of dietary toxins that accelerates this process and are studying how this occurs and how to prevent it.

Our laboratory explores why and how the normally protective immune system ‘turns inwards’ and attacks healthy tissues of the body affected by autoimmune (insulin dependent) diabetes mellitus (DM) and rheumatoid arthritis (RA).

In autoimmune DM, insulin-producing cells in the pancreas are attacked, resulting in high serum levels of autoantibodies to a protein called GAD65. But these autoantibodies don’t react with a closely related molecule, GAD67. This autoantibody puzzle was investigated by making crystal structures of both GAD65 and GAD67, in collaboration with Professor James Whisstock from the Department of Biochemistry and Molecular Biology.

Autoantibodies from patients with autoimmune DM bind to a ‘super hotspot’ within the crystal structure of GAD65 that is not present in GAD67. This structural difference may explain why GAD65 only reacts with autoantibodies.

In RA, autoantibodies are produced against type II collagen – a major protein of the joint cartilage destroyed by the disease. Mice immunised with cartilage collagen produce similar autoantibodies and, develop an arthritis very similar to human RA. If purified autoantibodies to type II collagen from arthritis-affected mice are given to unimmunised mice, they also develop the disease, with inflamed joints and damaged cartilage.

We have shown that these autoantibodies also damage the structure of isolated cartilage in tissue culture. Swedish colleagues have shown that these antibodies that cause severe arthritis in mice, and which cause cartilage damage in tissue culture, also occur in human RA, where they are associated with severe disease. It is likely that autoimmunity to collagen contributes to the damage to cartilage that occurs in RA and may occur independently, or together with inflammatory mechanisms.

The study of molecular regions of ‘self’ molecules (epitopes), which are implicated in autoimmunity, may be translated to improved diagnosis and therapies for autoimmune diseases.

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The study of molecular regions of ‘self’ molecules (epitopes), which are implicated in autoimmunity, may be translated to improved diagnosis and therapies for autoimmune diseases.
Steroid hormones help to maintain the normal efficient operation of our physiological systems. Their inappropriate action can lead to common adult human pathological conditions such as hypertension, heart failure and metabolic syndromes.

Steroid hormones exert their effects through intracellular steroid receptors and are members of the nuclear receptor superfamily of ligand-dependent gene regulators. We study their signalling pathways in the developing lung in preterm babies, immune system control of leukaemia and depression, utilising a range of molecular, cellular and animal-based systems. We also assess their potential use in stem-cell based respiratory therapeutics and for treatment of other diseases.

**NHMRC Program Grant**
- Novel strategies for improving respiratory support and outcomes for very preterm babies (2006-2010).

**NHMRC Project Grant**
- A T Cell-Specific GR Promoter Determines Responsiveness to Glucocorticoids in Different Immune Compartments (2005-2007).

**ARC Grant**
- Regulation of stress hormone receptors in the brain (2006-2008).

**Awards and achievements**

**Invited Speakers**
- Associate Professor Cole: Endocrine Society of Australia meeting, Christchurch, New Zealand.
- Dr Mollard: University of Pennsylvania, US; CEINGE Biotecnologie Avanzate, Naples, Italy; Shenzhen University, Shenzhen, China; and City University, Hong Kong, China.

**Committee and Other Involvement**
- Dr Mollard: Selection committee, International Society for Stem Cell Research meeting, Cairns, Australia; Education committee, International Society for Stem Cell Research.
- Associate Professor Cole: Council of the Endocrine Society of Australia; NHMRC grant review panel.

(A) Aggregate co-culture of dissociated E11.5 mouse lung with embryonic stem cells (ESCs) and embryoid bodies (EBs).

(B) Double immunohistochemistry for ESCs (green) and either pan-keratin (red) or surfactant protein C (red) shows that these glandular ducts contain ESC derivatives differentiated as epithelial-like cells.

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**www.med.monash.edu.au/biochem/staff/tim-cole.html**

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**Fetal and Neonatal Research Group**

**Associate Professor Stuart Hooper,**
**Professor Graham Jenkin (see Immunology and Stem Cells page 24) and Associate Professor David Walker**

Members study how critical organ systems of the fetus and newborn develop under normal and altered conditions, the causes and consequences of intrauterine growth restriction, and how fetal and neonatal environment can ‘program’ an individual’s health for life.

The group consists of three main laboratories headed by Associate Professor Hooper, Professor Graham Jenkin and Associate Professor David Walker.
This laboratory focuses on fetal lung development and how the lung transforms into an efficient gas exchange organ at birth. Failure of the lung to take over the role of gas exchange at birth is the greatest cause of death and disease in newborn infants. This occurs if the lungs have not developed properly during fetal life or if the infant is born prematurely before the lungs have developed properly. Babies born prematurely usually require the assistance of a ventilator to breathe, but this can injure their lungs and cause abnormal lung development.

This research aims to determine the factors controlling normal and abnormal lung development. It also focuses on how the lung transforms from a fluid-filled organ that plays no role in gas exchange, to an air-filled organ that sustains the gas exchange requirements of the infant. We use a synchrotron to image the lung as it fills with air from birth and identify procedures that enhance this process.

NHMRC Program Grant
- Novel strategies for improving respiratory support and outcome for very preterm babies (2006-2010).

NHMRC Senior Research Fellowship
- (2007-2011)

Australian Nuclear Science and Technology Organisation Grants
- Dynamic phase contrast imaging of lung aeration at birth: the effects of positive end expiratory pressure and body position (2007).

Phase contrast X-ray image of a new born rabbit pup using X-rays generated by a synchrotron. This imaging technique allows us to see how air enters the lung at birth. Bubbles of air can also be seen in the pup’s stomach (bottom right of the image). The trachea and major bronchi (largest airways) are visible, as are the smallest airsacs (alveoli) (bottom left of the lung).

www.med.monash.edu.au/physiology/research/fetalandneonatal/fnld
Brain damage at birth may be subtle, resulting in learning disabilities and behavioural problems in children, or catastrophic, resulting in epilepsy, spasticity, and cerebral palsy.

I recently established a research group to examine how the brain is damaged by events that disturb the in utero environment and fetal development. In these studies we use pregnant sheep and a species new to this area of research, the spiny mouse. Here at Monash University, we have the only spiny mouse colony in Australia.

Our results show that brief episodes of fetal oxygen starvation, also called asphyxia, or exposure to low levels of infectious agents in the placenta, can induce inflammation-like reactions in the fetal brain, and produce behavioural abnormalities in newborn lambs and spiny mice. We are now evaluating treatments that can be given to the pregnant animal to protect the fetal brain from asphyxia and infection.

We have shown that supplementing the mother's diet with the essential nutrient creatine significantly improves survival of newborn spiny mice and prevents postnatal growth retardation that follows after birth asphyxia.

We also demonstrated that melatonin, when given to pregnant sheep, can prevent fetal brain damage caused by free radicals following intra-uterine asphyxia. These treatments could potentially be given to women during pregnancy to protect their offspring from brain damage.

Important questions arise from our research: can the developing brain repair itself after being damaged; are there processes in the fetal and neonatal brain that could be exploited to induce repair and recovery of the damaged brain?

Changes in the developing brain that may lead to brain damage in the newborn infant. The challenge is to prevent these pathological changes from occurring, rather than finding ways to rescue the already-damaged brain.
Our research goals are to understand the pathophysiology of Multiple Sclerosis (MS) and develop new cell-based treatments, where the immune system is altered by gene therapy and antigen-directed manipulation.

MS is the result of an attack of the brain and spinal cord when there is a breakdown in the tolerance to self.

Tolerance mechanisms permit the body to distinguish between foreign invaders such as bacteria and viruses and the body's own tissues. At present, the cause of MS remains a mystery, and there is no cure for this severe, neurodegenerative disorder. Although immune therapy is beneficial to some patients, others do not respond to any of the currently available treatments.

Our group focuses on research that combines the rapidly evolving, multi-potential applications of stem cells with our unique technology platforms, which bridge immunology, autoimmunity and stem cell research.

Our research aims to reverse the autoimmune damage in a mouse MS model (experimental autoimmune encephalomyelitis, or EAE), where we assess stem cell-based therapies together with thymus manipulation. We hope to restore tolerance to brain components that are attacked in MS, thus preventing and/or reversing disease symptoms without risk of relapse.

Our group also studies the cellular and molecular mechanisms that result in myelin damage and axonal degeneration in EAE and MS. We use powerful techniques such as focal plane array infrared imaging and infrared synchrotron microspectroscopy to probe chemical changes in the central nervous system of mice with EAE.

Infrared chemical imaging of MS-like lesions reveals differences in lipid and nucleic acid concentration within cerebellum tissue layers of four individual mice. These are compared to haematoxylin-eosin stained serial sections (EAE, left panel).

Classification of different regions of tissue in independent mice is based on a trained artificial neural network (ANN, right panel) that recognised spectra from different tissue types and EAE lesions in the mouse cerebellum. Spectra classified as belonging to the molecular layer are assigned blue, the granular layer is green, white matter is red and an EAE lesion is grey. Unclassified spectra are shown in black.
Immune Regeneration Laboratory

Acting Head (from September 2007), Monash Immunology and Stem Cell Laboratories

The focus of the Immune Regeneration Laboratory is to address the repair of the immune system, particularly the thymus, following atrophy as a result of ageing, chemotherapy, radiation therapy and severe infections such as HIV.

The thymus is a complex organ and produces immune cells called T cells, which ward off infections and cancer. However, it also eliminates newly developing T cells that may otherwise attack the body’s own tissues.

Paradoxically, the thymus shrinks profoundly from the onset of puberty when sex steroid levels increase. As a result, fewer T cells are produced in adults, who become more susceptible to infections, especially when the immune system is further damaged by severe infections such as HIV and by common cancer treatments such as radiation or chemotherapy. In addition, the degenerating thymus is less efficient at destroying self-reactive T cells, increasing the incidence of autoimmune conditions with age.

The bone marrow, where early T cell progenitors are produced, also deteriorates with age, again impacting on thymus function.

This laboratory has previously shown that temporary depletion of sex steroids by chemical means restores thymus size, structure and function, and the first clinical trial showing improved thymus function in cancer patients receiving chemotherapy and bone marrow transplants is nearing completion; two additional trials are currently underway.

If thymic function can be restored in adults, there is the potential to manipulate the immune system to prevent rejection of transplanted cells and tissues (including those generated from stem cells), and in the case of autoimmune disease, to restore the body’s tolerance to its own tissues.

Mice susceptible to autoimmune disease often show extreme thymus abnormalities, including enlarged, fibroblast-filled gaps in the epithelial cell network, and the development of B cell follicles.

(green = epithelial cells, red = B cells, blue = fibroblasts).

The embryonic stem cell (ESC) differentiation laboratory focuses on the directed differentiation of ESCs to mesodermal and endodermal cell types with a potential use in cell transplantation therapies.

The main interests of the laboratory include generating blood cells (to treat blood disorders and provide transfusible blood products), blood vessel cells (endothelium), heart muscle cells and pancreatic beta cells (for the treatment of type 1 diabetes) from ESCs.

The aim is to coax ESCs to form specific cell types or organs as would occur during embryonic development. To assist in the process, we have generated genetically modified mouse and human ESCs, which express green or red fluorescent proteins at specific stages during the development of these different cell types. Our laboratory is using these tagged human ESCs to define the growth factor requirements for differentiation of these cells towards blood, endothelium, heart and pancreatic cell types.

**Australian Stem Cell Centre Grant**

**NHMRC Research Fellowship**
- (2005-2009)

This image dramatically illustrates the ability of some blood cell progenitors to differentiate into both red and white blood cells. In this single blood cell colony, half of the daughter cells have differentiated along the red blood cell lineage (red fluorescence) and half have differentiated into white blood cells (green fluorescence).

Our current research interests focus on the control of ovarian function during the menstrual cycle and in early pregnancy; the initiation and maintenance of early pregnancy, development and wellbeing of the embryo and fetus; the initiation of normal and premature birth; and the use of stem cells in tissue repair and regeneration.

Our recent research findings may lead to novel approaches to prevent brain damage in at-risk fetuses, and better ways to monitor fetal wellbeing late in pregnancy.

Embryonic stem cells provide a potentially indefinite, renewable source of cells and tissue for research and transplantation. Multipotential stem cells of adult or placental origin also provide a readily available source of stem cells, which could potentially be used to treat medical conditions. Activating stem cells that already exist in a patient’s own body or delivering therapies containing adult-sourced or embryo-sourced stem cells creates opportunities for regenerating the human body in ways even recently thought impossible.

This laboratory studies the basic biology of stem cells and germ cells: how these cells can turn into other cells and interact with control systems in the human body. Our group can precisely identify stem cells; increase stem cell numbers without losing their diverse properties; and predictably and reproducibly coax these stem cells to produce specific cell types, which have the potential to regenerate human tissues and organs.

NHMRC Project Grant
• The effects of maternal glucocorticoid administration in growth restricted fetuses (2006-2008).

NHMRC Program Grant
• Control of reproductive processes (2005-2009).

National Institute of Health RFA Program Grant
• Molecular markers of oocyte quality and competence (2004-2008).

Awards and achievements
BrainLink Women of Achievement Award
• Dr Orly Lacham-Kaplan

Servier Award for Best Scientific Paper from an Early Career Scientist
• Dr Renea Taylor

Junior Investigator Poster Award, International Society for Stem Cell Research Conference
• Mr Jonathan Niclis

European Human Embryonic Stem Cell Registry Advisory Board Nomination
• Dr Anna Michalska

The Renal Regeneration Laboratory focuses on the development of new adult stem cell-based therapies that may offer alternatives for patients undergoing kidney transplantation and long-term dialysis.

Kidney disease causes debilitating health problems for millions of people worldwide. Progression to end-stage renal disease is now a critical health issue.

The incidence of chronic renal failure is rising rapidly at a rate of around six to eight per cent per year, due mainly to an alarming increase in Type 2 diabetes incidence. It is important to develop new treatments for kidney disease as there is poor quality of life associated with current treatment options, high health care costs and increasingly long organ transplant waiting lists.

Potential therapies for patients with renal disease may involve administering stem/progenitor cells or regenerative growth factors to slow the development of kidney disease and/or regenerate damaged kidney tissue. This laboratory studies embryonic and adult kidneys, which may provide clues about how renal regeneration can occur.

The Renal Regeneration Laboratory is interested in the cellular and molecular regulation of kidney repair and the sub-populations of bone marrow-derived cells that drive this process. There is increasing evidence that bone marrow-derived myeloid cells can play a beneficial proliferative, blood vessel forming, and scar removing role that promotes cellular regeneration and tissue remodelling.

Bone marrow cells (green) help maintain normal kidney function and repair the injured kidney.

www.med.monash.edu.au/misc/research/renal-regeneration.html
Infectious Diseases

Pathogenesis and Immunity in Bacterial Infections

Research in this group focuses on how bacteria infect their human or animal hosts, how they cause disease, and the host responds to infection.

We use genomics, proteomics and microarray technology – coupled with molecular biology and infection models – to investigate the interaction of pathogenic bacteria with their hosts at the cellular and molecular level, including the host response to infection. We study Infectious diseases including: bacillary dysentery, melioidosis, leptospirosis, fowl cholera and swine dysentery. The lab is also developing vaccines against several bacterial pathogens.

NHMRC Program Grant

ARC Linkage/Pfizer Animal Health
- Vaccine against leptospirosis (2006-2008).

ARC Linkage/Intervet International

Australian Poultry CRC
- Identification of vaccine antigens from Clostridium perfringens and Campylobacter jejuni (2006-2008).

Awards and achievements
- ARC Centre of Excellence in Structural and Functional Microbial Genomics – Professor Adler is Centre Director.

Editorial Boards
- Professor Adler: Veterinary Microbiology; Veterinary Sciences Tomorrow.

Biology of Granzymes and Granzyme Inhibitors

We are interested in the killing mechanism of cytotoxic lymphocytes, the white blood cells that eradicate virus-infected or cancer cells from the body.

To kill abnormal cells, cytotoxic lymphocytes produce two key molecules: a pore-forming protein called perforin and a protease called granzyme B. Perforin allows entry of granzyme B into target cells where it triggers cell death by activating caspases.

How perforin delivers granzyme B is unclear. But in a collaborative study led by Professor James Whisstock, we have identified the three-dimensional structure of a related bacterial protein, which suggests that perforin acts like bacterial cytolsins and punctures membranes.

How and when granzyme B is released from cytotoxic lymphocytes and enters target cells is still under investigation. We have identified regions on granzyme B that are required for its entry into cells, and have shown that it has an extracellular matrix-remodelling function.

Therefore, granzyme B has additional roles beyond initiating apoptosis in compromised cells. Recent results show that it may help cytotoxic lymphocytes move through tissue, and control bleeding by cleavage of von Willebrand factor.

In addition, cytotoxic lymphocytes contain a specific granzyme B inhibitor called PI-9, which protects these white blood cells from dying. Some cancers express high levels of PI-9 which might explain why they can evade the immune system. We are now studying the distribution and function of PI-9 within cytotoxic cells, and are analysing mice lacking this gene.

NHMRC Program Grant

ARC Discovery Grant

www.med.monash.edu.au/microbiology/staff/adler/

www.med.monash.edu.au/biochem/staff/bird.html
**Bacterial Pathogenesis**

We study bacterial pathogens to find out how bacteria cause disease and to allow us to design more efficacious vaccines to prevent disease.

We work closely with the laboratory of Professor Ben Adler to identify the genes critical for bacterial virulence and study the surface components of selected pathogens: *Pasteurella multocida*, *Burkholderia pseudomallei*, *Clostridium perfringens*, *Campylobacter jejuni*, *Brachyspira hyodysenteriae* and *Dichelobacter nodosus*.

The bacterial surface is the site of interaction between the bacteria and the host. For Gram-negative bacteria such as *P. multocida*, the surface is composed of proteins, polysaccharides and lipopolysaccharides (LPS).

We have determined the structure of the LPS molecules expressed by various strains of *P. multocida*, and identified the proteins required for LPS synthesis. We hope to identify the key amino acids within these proteins which determine their functional specificity. This will enable the design of drugs that can inhibit LPS biosynthesis.

We used bioinformatics and proteomic techniques to identify the outer membrane proteins of *P. multocida*. By systematically inactivating the genes encoding more than half of these surface proteins, we showed that two are critical for virulence. We also studied the surface protein TolC and demonstrated that it was critical for bacterial resistance to various drugs and antibiotics.

We aim to develop vaccines against *P. multocida*, *C. perfringens*, *C. jejuni* and *D. nodosus*, and are currently testing surface proteins as candidate vaccine antigens in relevant animal models. These vaccine trials are ongoing and we have identified one strongly protective *P. multocida* antigen.

**NHMRC Project Grant**

**Poultry CRC Project Grant**
- Identification of vaccine antigens from *Clostridium perfringens* and *Campylobacter jejuni* (2005-2008).

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**Malaria and Other Parasites of Red Blood Cells**

The laboratory studies how parasites of red blood cells (particularly malaria and babesia) cause disease and death in humans and animals, so that new drugs or vaccines can be developed.

Malaria is central to our research activities because it affects over half of the world’s population and kills over three million people each year.

The group also studies Babesia parasites as these cause a malaria-like disease in cattle that results in huge economic losses to the beef and dairy industries worldwide. Our group has shown that both these parasites make red blood cells stiff and sticky, which causes them to lodge in vital organs such as the brain.

The laboratory aims to identify proteins that cause these changes in red blood cells, so that new prevention and treatment strategies can be developed. The work is recognised and supported both nationally (NHMRC Program in Malaria) and internationally (NIH, USA).

**NHMRC Senior Research Fellowship**
- (2003-2008)

**NHMRC Program in Malaria**
- (2005-2009)

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**Associate Professor Brian Cooke**

**NIH RO1 on Malaria and Red Blood Cells**
- (2006-2010)

**Awards and achievements**

**Associate Professor Cooke**
- Award: Inaugural NHMRC Science to Art Award.
- Editorial Boards: Blood; Trends in Parasitology.
Malaria and Tuberculosis

**Professor Ross Coppel**

**National Institutes of Health R01 Grant**

**NHMRC Program Grant in Malaria**
- From target identification to therapeutics (2005-2009).

**ARC Centre of Excellence in Structural and Functional Microbial Genomics**
- (2005-2010)

**National Institutes of Health Project Grant**
- Investigations into the pathogenesis of primary biliary cirrhosis (2006-2010).

**The Victorian Bioinformatics Consortium**

The VBC, which is directed by Professor Ross Coppel, brings together more than 50 researchers with expertise in medicine, biotechnology, agricultural and veterinary research, bioinformatics, statistics and computer science. The Consortium conducts research in the following bioinformatics areas:
- Genomic analysis – to predict gene function from sequence information of microbial genomes
- Functional genomics analysis of microarray data
- Integrative databases

**www.med.monash.edu.au/microbiology/research/coppel.html**

Molecular Analysis of Bacterial Pathogens

**Professor John Davies**

This laboratory studies bacteria that cause infectious diseases in humans and animals, so that we can understand how bacteria and the host respond to each other during infectious processes.

**National Institutes of Health RO1 Grant**

**NHMRC Program Grants**
- Regulatory networks controlling the interaction of *Neisseria gonorrhoeae* with the human host (2007-2009).

**ARC Centre of Excellence in Structural and Functional Microbial Genomics**
- (2005-2010)

**www.med.monash.edu.au/microbiology/research/davies.html**
Infectious Diseases

Eukaryotic cells, which contain a nucleus, degrade unwanted parts of their internal structure by the process of autophagy (“self eating”). In yeast, autophagy acts to remove unwanted or damaged components of these cells and helps them adapt to starvation.

However, in mammalian cells, this mechanism also plays a role in programmed cell death and other tissue-specific functions. In addition, defects in autophagy may contribute to pathological conditions including: neurodegenerative and muscle tissue diseases, and some forms of cancer.

Our laboratory focuses on the following projects:

- **Organelle turnover by autophagy**
  As the nucleus is the control centre of the cell and contains the cell’s genetic information, it might be thought that degradation of nuclear contents would be strictly ‘off-limits’. However, it has been suggested that parts of yeast nuclei can be degraded by an autophagic process. We used a fluorescent biosensor to confirm this view. We are now trying to better understand this mechanism and its importance for cell function.

- **Autophagy in bacterial infection of mammalian cells**
  Successful micro-organisms have developed strategies to avoid autophagy, in order to survive in animal or human cells. We have studied the soil bacterium *Burkholderia pseudomallei*, which causes the human disease Melioidosis, common in tropical regions including northern Australia. Our studies are the first to show that autophagy of this bacterium can occur in infected cells. However, this process is inefficient and not all bacteria are destroyed. We are now working to understand what prevents autophagy from working at maximum efficiency.

- **Autophagy in human embryonic stem cells**
  Human Embryonic Stem cells (hESC’s) hold great promise as a renewable source of cells for use in research and regenerative medicine. We have shown that autophagy occurs in hESC’s and are now studying how this process is regulated when cells develop into more specialised cell types.

**ARC**

**Awards and achievements**
- Professor Rod Devenish
  - Editorial Board: Autophagy.

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**Autophagy Laboratory**

**Professor Rod Devenish**

**Research Fellows**
- Dr Lan Gong
- Dr Xueli Li

**PhD Students**
- Ma Tanya D’Cruze
- Mr Dalibor Mijaljica
- Mrs Kristina Youngs

**Masters Student**
- Mr Tim Tra

**Honours Students**
- Ms Juliana Bey
- Ms Lena Schreider

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**Autophagy of *Burkholderia pseudomallei* in mammalian cells**

Cells expressing GFP-LC3 were infected with *B. Pseudomallei* (Bp). The GFP (green) tag attached to LC3 enables visualisation of autophagosome structures enclosing bacteria (labelled with antibodies that are conjugated to Texas red).

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www.med.monash.edu.au/biochem/staff/devenish.html
The laboratory studies how the immune system recognises and responds to the stomach disease-causing bacterium *Helicobacter pylori*.

In 2005, two Australian clinicians, Dr Barry Marshall and Dr Robin Warren, received the Nobel Prize for the discovery of *H. pylori* and its role in gastric cancer and peptic ulcer disease.

Our laboratory uses *H. pylori* as a model of infection to study how the host immune system recognises disease-causing bacteria. Among the important findings of our work, we showed that the immune molecule NOD1 plays a key role in these responses. NOD1 recognises a component of the bacterial cell wall called peptidoglycan, which it presents to host cells via a specialised delivery system within the bacterium. We also study how peptidoglycan is delivered to host cells and how NOD1 triggers inflammatory responses. Inflammation precedes gastric cancer formation, a condition that causes millions of deaths worldwide each year.

**NHMRC Project Grants**

- The role of the intracellular pathogen-recognition molecule NOD1 in the host response to *Helicobacter pylori* infection (2005-2007).

**The CASS Foundation Limited**

- Understanding the molecular processes involved in *Helicobacter pylori* induced inflammation; a precursor of peptic ulceration and stomach cancer (2007).

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The recently established Animal Biotechnology Research Laboratory (ABRL) studies how allergic processes protect humans and animals from internal parasites and also trigger disorders such as asthma.

Parasitic diseases are a major concern to sheep producers worldwide and cause malnutrition in children in developing countries. In collaboration with a commercial partner, we are developing vaccines to protect sheep against gastrointestinal parasites. These vaccines will also serve as valuable models to protect livestock and humans against other parasitic diseases.

The same immune system processes that protect the body from parasites also play a role in allergic diseases, which are increasingly common in developed countries. Using sheep as an animal model for human allergies and asthma, we hope to unravel the immune mechanisms that lead to allergic responses, and develop new treatments for asthma and other allergies.

ABRL research is applied to human and animal health, and biotechnology. We train and collaborate with international scientists, and in 2007 hosted researchers from Iran, Thailand, Canada, Belgium and Spain.

**ARC-Linkage (with Pfizer VMRD)**

- Development of prototype vaccine against gastrointestinal nematode larvae (2006-2011).

**NHMRC Ind Fellowship (with Amrad/Zenyth)**


**Commercial Ready Grant matched by Circadian Technologies**


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Confocal images of *H. pylori* membrane “blebs” (red) entering epithelial cells. Cells were treated (Panels B and D) or not (Panels A and C) with a chemical that interferes with lipid-enriched domains within host cell membranes. Maximal bleb entry is seen in untreated cells (Panel A). To confirm bleb internalisation, cells were suspended in a detergent (Panel C), or left untreated (Panel D). Here, internalised blebs appear as yellow specks.

Binding of an eosinophil-specific molecule, galectin-14, to the mucus and goblet cells of the airways (A: rGST-Ga1-14- FITC; B: rGST- FITC control).
Infectious Diseases

Research focuses on virus-like particles called nanoparticles that can be incorporated into new vaccines.

Virus-like particles (VLPs) are non-infectious but immune stimulating due to their organised and repetitive structures. This laboratory designs modified viral proteins with the ability to form VLPs, and studies the mechanisms that lead to successful and protective immune responses. Engineered, modified VLPs have the potential to induce immune responses against infectious agents including: hepatitis C virus, human immunodeficiency virus and influenza virus.

**NHMRC Project Grant**

**Ramaciotti Establishment Gift**

**Awards and achievements**

**Young Investigator Award**
- Ms Wan-Shoo, IX International Symposium on Respiratory Viral Infections, Hong Kong, China.

**Molecular Virology**

Research Fellow
Dr Gerard Devitt

PhD Students
Ms Wan-Shoo Cheong
Ms Patricia Vietheer

Honours Student
Ms Teresa So

www.med.monash.edu.au/microbiology/research/netter.html

**Protease Laboratory**

**Head, Department of Biochemistry and Molecular Biology**

In 2007, the Protease Laboratory gained insights into the function of enzymes from bacteria that cause disease, and enzymes from the host which act to prevent bacterial diseases.

The laboratory carried out studies mapping the responses of host cells to enzymes from a bacteria which causes gum disease.

We have shown that a particular protein on the surface of cells of the immune system is vital in causing disease associated with infection by this bacterium. This suggests that molecules which antagonise the function of the host molecule might therefore be able to prevent the disease.

We have also shown that enzymes from the complement system that are involved in host defence against bacteria are regulated by three critical interactions with the proteins that they interact with in order to achieve their role. While these enzymes are crucial to host defence systems, they also can contribute to disease when they are not properly regulated.

**Associate Professor Robert Pike**

Therefore, our work in 2007 provided avenues towards developing molecules to dampen the action of these enzymes in certain situations, thus lessening their disease effects. The common theme in the laboratory is the development of mechanisms and molecules to prevent diseases that have inflammation as their basis. The work achieved so far moves us closer to achieving this.

**CRC for Oral Health Sciences Project Grant**

**Awards and achievements**

**President, International Proteolysis Society (2005-2007).**
- Associate Professor Pike

www.med.monash.edu.au/biochem/staff/pike.html
Functional Biology of Bacterial Pathogens

The Rood laboratory studies the function of anaerobic bacteria.

We use molecular genetics approaches to explain how these bacteria cause disease in humans and animals, how the production of bacterial toxins and virulence factors is regulated, and virulence genes and antibiotic resistance genes are transferred between bacteria. We hope to understand bacterial evolution and disease formation, and find new methods to control and treat bacterial infections.

Our laboratory has sequenced the complete genome of a bacterium that causes footrot in sheep. These studies may lead to the development of a new vaccine to control and treat this economically devastating disease. Other research discoveries include: unravelling how a toxicity gene transfers information from one bacterium to another in animals, and identifying how a regulatory protein controls toxin production in a major human gastrointestinal pathogen.

NHMRC Project Grant

NHMRC Project Grant

ARC Centre of Excellence in Structural and Functional Microbial Genomics
- (2006-2010)

Molecular Biology of the Mycobacteria

The Stinear lab studies how related bacteria called mycobacteria cause diverse diseases such as tuberculosis and Buruli ulcer.

We focus on how these mycobacteria produce different molecules that suppress the human immune system and ways to prevent their action. The laboratory also searches/screens for genes from complete mycobacterial DNA sequences, which are recognised by the immune system. These proteins, known as antigens, can be used to develop rapid and simple diagnostic tests for Buruli ulcer.

NHMRC Project Grant

NHMRC RD Wright Fellowship
- (2006-2010)
Our clinical and basic projects focus on three primary areas of research:

1. Acute and delayed-onset bioeffects of ultrasound: evaluating the link between adverse effects of ultrasound and adult-onset disease.

   This laboratory-based project uses animal models to investigate renal and cardiovascular disease after repeated exposure of the fetus to B-mode and Doppler ultrasound. Information is also collected on sonographers’ work practices and the expectations and knowledge of pregnant women regarding antenatal ultrasound scans.


   Current clinical studies investigate the use of Magnetic Resonance Imaging (MRI) and ultrasound in sports injuries, as well as the effectiveness of Computed Tomography (CT) and ultrasound-guided interventions for pain management of painful joints.

3. PET in patients with breast cancer.

   This project compares the predictive value of Positron Emission Tomography (PET) to mammography, clinical and molecular markers when determining a patient’s response to chemotherapy.

   **Aventis-Sanofi**

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We develop and test compounds to enhance image contrast in clinical diagnostic imaging, including CT and MRI.

Most CT and many MRI patient examinations require administration of an intravenous compound to enhance contrast. However, existing compounds may, rarely, cause fatal reactions, such as iodinated compounds used for CT, or offer insufficient contrast to enable a diagnosis. This work, in collaboration with Dr Phil Andrews and Professors Peter Junk and Glen Deacon in the School of Chemistry, employs novel cluster chemistry to develop non-iodinated compounds, based upon rare earth elements and bismuth, resulting in improved contrast at selected X-ray energies.

These molecules are being tested on an in-house CT scanner, at MRI facilities of affiliated teaching hospitals, and in the laboratories of collaborators in Berlin. Some of these compounds have shown potential for multimodal imaging in both CT and MRI, and we are also researching the fluorescence properties for potential optical imaging.

**Schering AG Industry Grant**
Neuroscience

Nuclear Signalling Lab
The laboratory focuses on the function of brain cells called astrocytes.

While ten per cent of the brain consists of neurons, which are responsible for word movement and thinking, the bulk is made up of glial cells. Scientists have believed that astrocytes, a glial cell known for its distinctive star-like shape, provide mechanical and metabolic support for neurons, by maintaining the environment in the brain.

What does maintaining the brain environment mean? Our research shows that astrocytes actively regulate nerve cell activity and may play important roles in learning and memory.

NHMRC Project Grant

Metabolism Neuroscience and Reproductive Neuroendocrinology

Head, Department of Physiology

Professor Clarke heads a laboratory devoted to the study of neuroendocrinology, with a focus on large animal models and novel methodology. The work is aimed at understanding the mechanisms of reproduction, stress and regulation of body weight (obesity).

Significant published research findings are as follows:

• Kisspeptin, a small brain protein, controls ovulation timing in both cyclic and acyclic female sheep.
• Estrogen has rapid effects on pituitary gland cells via membrane receptors.

Other projects conducted by Honours and PhD students include:

• Gonadotropin release inhibiting hormone (GnIH)
We recently discovered that GnIH is produced in the mammalian hypothalamus and determined its function.

• Pro-opiomelanocortin (POMC) cells as gatekeepers of energy utilisation
This project tested the hypothesis that POMC cells detect multiple signals of energy balance (ghrelin and leptin) and play a role in determining fuel availability.

• How the brain responds to altered body weight
This project determined changes in the expression of appetite regulating peptide genes in the brains of sheep in various physiological situations.

NHMRC
• Kisspeptin control of reproduction (2006-2008).
ARC
• Rapid estrogen effects (2006-2008).
National Institute of Health
• Metabolic fuels and reproduction (2006-2008).

Immunostaining of cells of the arcuate nucleus in the hypothalamus of the brain showing co-localisation of two different peptides in the same cells.

www.med.monash.edu/physiology/staff/clarke.html
Sensory Neuroscience

The laboratory studies how the miniature brains of bees solve complex visual tasks including facial recognition.

I collaborate with European research groups in a field that has attracted significant interest and funding from the US Air Force and the ARC. These studies highlight the value of understanding how a brain with less than one million neurons can, with the correct conditioning, learn to solve tasks that we previously thought needed a larger brain. They also show how different biological brains perform the same function, and may help future machines ‘see’ better.

Other research addresses how bees perceive cues like temperature when pollinating flowers. This work has significant implications for our understanding of the effects of global warming on pollination, crop production and plant diversity.

USAF AOARD
- Face recognition and processing in a mini brain (2006-2007).

Collaborators
- Professor Christa Neumeyer, Johannes Gutenberg University, Germany.
- Professor Martin Giurfa, University Paul Sabatier-Toulouse, France.
- Dr Johannes Spaethe, University of Vienna, Vienna, Austria.

Molecular Neurobiology Lab

The laboratory investigates the regulation of adult neural stem cells by hormones and growth factors.

Our research focuses on how neural stem cells and progenitors develop into functional neurons and supporting cells. In 2007, we published a major paper in the Stem Cells journal on the role of the c-myb gene, working with a team at Peter MacCallum Cancer Centre, University of Melbourne and Monash University.

This laboratory also studies the role of supporting cells in neuronal development and how stress and ageing affect the generation of new neurons in animal models.

The ultimate aim of these studies is to develop treatments that overcome limited brain repair as a result of injury and disease.

Visiting PhD Students from University of Melbourne
- Mr Kwok Ho
- Mr Christopher Choy

Awards and achievements
- Dr Nichols
  - Honorary Senior Research Fellow: Centre for Neuroscience, University of Melbourne
  - Fellow: Brookdale Institute on Aging and Longevity, New York, USA

Dr Adrian Dyer

Dr Nancy Nichols
This research focuses on understanding the brain mechanisms that contribute to obesity. Our research projects are guided by two key views: 1) energy expenditure (rather than energy intake) is a valuable treatment approach to combat obesity; and 2) we need to better understand how reward pathways in the brain play a role in overeating.

Our laboratory examines the role of energy expenditure in animal models that range from antipsychotic drug-induced weight gain to the actions of cannabinoid receptor inhibitors as potential treatments. We also study how infections may influence hunger and body weight.

Other projects include: identifying cerebral cortex regions that encourage eating in obesity, and conversely, how neurochemical activation of reward pathways can rescue animals from weight loss.

We hope that this multifaceted approach will provide clues about how the brain regulates body weight, and how genes and their protein products may be used for antiobesity therapies.

NHMRC Principal Research Fellowship
- (2006-2010)

NHMRC Project Grants

Sensory Neuroscience
The laboratory investigates the function of the regions of the cerebral cortex that process sensory information. This work covers two broad areas: neuronal studies in the somatosensory cortex that processes information from touch, and psychophysical studies on how humans understand sensory signals in the presence of competing signals.

Our work covers diverse topics in these two broad areas. In psychophysics we study topics such as how bilingualism, with acquisition of English late in childhood, affects our ability to learn to understand English speech in the presence of background noise.

Associate Professor Ramesh Rajan

In the neuronal processing studies we study topics such as how changing the complexity of a rat's environment alters how its cortex processes information from the face whiskers which, like our fingers, are used to explore the world through touch.

NHMRC Project Grant
This group of three laboratories focuses on understanding the important physiological functions of contraction, secretion and cellular communication. Disturbances in these functions underpin many diseases.

Research projects focus on understanding:

1. Blood vessel wall dysfunction in diabetes, pregnancy-induced hypertension, gestational diabetes and vasospastic syndromes, or as a result of insults to the developing fetus experiencing vitamin D insufficiency, hypoxia, growth restriction or excessive maternal intake of alcohol;

2. Remodelling of smooth muscle structures and contractions when labour is premature or fails at term, or after obstruction or infection of the bladder and ureter; and

3. Intra- and inter-cellular signalling between neurons and astrocytes, and how failure of these processes gives rise to epilepsy, dementia and Alzheimer’s disease.

**NHMRC Grants**


**ARC Grants**

- Do depolarising currents in the endothelium evoke contraction of vascular smooth muscle? (2005-2007)

**Awards and achievements**

- Perinatal Society Prize for Early Career Researcher
  - Ms Kristin Bubb

**Research Fellows**

Dr Harold Coleman
Dr Marianne Tare
Dr Natalie Alexopoulos

**Research Assistant**

Ms Mary Tonta

**PhD Students**

Ms Kristin Bubb
Ms Jyothsna Rao
Mr Sean Yan
Mr Marc Mazzuka
Ms Bobbi Slattery
Ms Kelly Kenna

**Honours Student**

Ms Amy Sutherland

**Contact Information**

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www.med.monash.edu.au/physiology/staff/wendt.html
When we open our eyes, we are immediately rewarded with information about the shape, colour, texture, location and motion of different objects in the environment, as well as their significance for our behaviour. Visual perception is such a fundamental part of our lives that we tend not to consider the immensely difficult computational problem that it represents. While modern sensor technologies allow us to access images well beyond the capabilities of the human eye, the task of processing and making sense of visual information, particularly in changing conditions, is one that artificial systems can only tackle to a limited extent. Our visual system represents a true marvel of design, given its capacity to interpret complex environments in a manner that is fast and reliable.

Our laboratory’s research program is founded on the desire to understand the cellular mechanisms that underlie these remarkable abilities. The long-term aim of this type of work is to generate ‘circuit diagrams’ of visual processing in the brain, down to the level of cell-cell interactions, so we can understand how we extract meaning from the images captured by the eyes. This knowledge may one day facilitate the design of machines that can interpret visual scenes in a manner that is fast and reliable.

We know that visual perception is the result of electrical activity in brain cells, and that the characteristics of the visual image are encoded by these cells in terms of a digital ‘language’ based on electrical pulses (action potentials) generated across their membranes. The rate of action potentials generated by each cell is determined dynamically, based on the integration of the connections it receives, through synapses, from other cells. Thus, achieving a detailed understanding of the way in which the visual system operates depends on understanding how brain cells connect to each other to create this ‘electrical code’.

NHMRC

ARC

ARC Linkage International
- Understanding how the brain uses sensory information to guide reaching and grasping movements (2007-2008).

Awards and achievements

Professor Rosa
- Member: ARC College of Experts (Biological Sciences and Biotechnology) and NHMRC grant review panel 4f (Neurology and Neuroimaging).
- Fellow: Institute of Advanced Studies, University of Bologna, Italy.

www.med.monash.edu.au/physiology/staff/rosa.html
Deputy Head, Department of Physiology

Our research focuses on the behavioural and physiological consequences of stress. We are also interested in disseminating the mechanisms underlying regulation of reproductive function and lactation.

Different physiological states influence stress responsiveness. We have identified mechanisms by which lactating females show reduced stress responses. This finding has important clinical relevance. In 2007, we showed that animals cope differently to stress according to weight: higher adiposity leads to greater stress responses compared to those seen in lean animals.

This discovery has important implications for stress-induced diseases that are exacerbated in overweight or obese animals and possibly in humans, which we will address in future clinical studies. We have also demonstrated that stress impacts female sexual behaviour, as stress reduces both the ability of females to attract males and their motivation to mate. This finding provides important insights regarding the success of reproduction in animals and humans. Research is currently underway to explain the effects of maternal stress on offspring development.

www.med.monash.edu.au/physiology/staff/tilbrook.html
Our laboratory focuses on identifying the sources of reactive oxygen species (ROS) in blood vessels, to develop drugs that inhibit the production of these toxic molecules and thereby prevent atherosclerosis – a disease of the blood vessel wall that is the major cause of heart attacks and strokes.

ROS are a family of toxic molecules which include chemicals such as superoxide and hydrogen peroxide. ROS are normally produced at low and relatively harmless levels in cells as by-products of oxygen metabolism. However, in patients with hypertension, diabetes and high cholesterol, ROS production in blood vessels markedly increases. At these excessive levels, ROS can trigger processes that can lead to plaque formation in arteries: inactivation of the protective hormone nitric oxide, inflammation, and oxidation of lipids and proteins.

We have shown in animal models of vascular disease and genetically modified mice that an enzyme called NADPH oxidase (Nox) increases ROS production in blood vessels affected by hypertension and high cholesterol levels. Therefore, if Nox activity is blocked with drugs, it may be possible to prevent atherosclerosis from occurring with a potentially new treatment strategy.

We are collaborating with the Monash Drug Discovery Biology Laboratory to theoretically predict the three-dimensional structure of NADPH oxidase and identify ‘pockets’ that could be targeted by small molecule inhibitors.

**NHMRC Project Grants**
- Is NADPH oxidase the trigger for accelerated atherosclerosis caused by bacteria? (2007-2009)

**Associate Professor Wayne Hodgson**

In 2007, the Monash Venom Group examined the pharmacological activity of a range of Australian and South-East Asian animal venoms.

We studied venoms of: Box jellyfish, ‘Irukandji’ jellyfish, Collett’s snake, Sri Lankan and Indonesian Russell’s vipers, Coastal taipan and Australian theraphosid spiders, otherwise known incorrectly as ‘tarantulas’. In addition, we examined the bioactivity of synthetic peptides that are based on lizard venom components. We also test the effectiveness of commercially available antivenoms against life-threatening venoms, identify and study individual toxins and determine their function. This research will identify novel toxins that can be used in biomedical research or as potential treatments for poisoned patients.
The figures are astounding: cardiovascular disease (CVD), such as coronary and peripheral artery disease, angina pectoris and stroke, represent the number one cause of death worldwide. CVD affects one in every six Australians, a figure that will increase to one in every four by mid-century. Also, an Australian dies from CVD every ten minutes. At some stage in our lives, we are all touched by heart attack or related diseases, either through personal affliction or through someone we know.

Current treatments often come too late and primarily treat symptoms of diseases rather than their causes. Moreover, patients at risk are poorly identified and the efficacy of individual treatments cannot be monitored. We therefore urgently need to move from treating symptoms to preventing disease, and diagnose patients at risk, and design individualised, mechanism-based therapies for CVD that prevent disease outbreak or progression. Consequently, the major research direction of the Vascular Drug Discovery Group is to identify and target the underlying mechanisms of cardiovascular disease in blood vessels to preserve and improve health, and cure vascular disease. This will ultimately result in a decline in CVD morbidity, mortality and disability. We have discovered new diagnostic approaches and novel new drug candidates, which we are testing in mouse models of CVD.

NHMRC Grants
- Anti-atherosclerotic effects of angiotensin fragments and non-AT1 receptors: Validation as innovative therapeutic targets (2007-2009).
- Isoforms of NADPH oxidase in oxidative stress and endothelial dysfunction in hypertension (2006-2008).

NHMRC Equipment Grant
- Characterisation of Ligand/Protein Interaction by Electron Paramagnetic Resonance (EPR) and Stopped-Flow Spectroscopy (2007).

Australian Research Council
- A redox sensor and triple receptor function for guanylyl cyclase (2006-2008).

ARC LIEF Grant
- A National Biomedical Electron Paramagnetic Resonance and Molecular Imaging Centre (2007).

National Heart Foundation Grants

Awards and achievements
- Our group has formed a strategic alliance with Servier Pharma.
- Ms Ravina Ravi and Ms Jennifer Irvine received several poster prizes at scientific meetings.

Professor Schmidt
- Editor: Journal of Molecular Medicine and Public Library of Science ONE.
The Drug Discovery Biology laboratory focuses on understanding how drugs, hormones and natural chemicals act at the surface of human cells.

The optimum functioning of living cells – and consequently the health of the entire organism – depends on how cells respond to the many physical and chemical stimuli that continually bombard them.

The majority of molecules that target cells are hormones and neurotransmitters, which bind to specific cell surface receptor proteins. G-protein coupled receptors (GPCRs) represent the largest superfamily of all receptors (approximately two per cent of the human genome) and are the targets for nearly 40 per cent of all currently used therapeutic drugs. Our laboratory aims to understand how GPCRs are regulated in order to identify novel approaches for drug discovery. We study GPCR structure/function and use GPCR models that are relevant for the treatment of metabolic, cardiovascular and neurological disorders.

**NHMRC Project Grants**

**NHMRC Principal Research Fellowship**
- (2004-2008)

**NHMRC Senior Research Fellowship**
- (2003-2007)

**Awards and achievements**
- **Professor Christopoulos**
  - 2007 ASCEPT Visitor to the British Pharmacological Society.
  - 2007 Cosmos Magazine Bright Spark Award.
- **Professor Sexton** (convenor with Professor Christopoulos)
  - 4th International Molecular Pharmacology of GPCRs 2007 meeting.
- **Dr Vimesh Avlani**
  - 2007 Addex Prize, 4th International Molecular Pharmacology of GPCRs meeting.
- **Ms Emma van der Westhuizen**
  - 2007 ASCEPT Prize, 4th International Molecular Pharmacology of GPCRs meeting.

**NHMRC Project Grants**
- A high content analysis facility (2007).

**Australian Research Council (APAI)**

**Australian Research Council (LIEF)**

**Ian Potter Foundation**

**GlaxoSmithKline**

**Pfizer (UK)**

**Awards and achievements**
- **Professor Christopoulos**
  - 2007 ASCEPT Visitor to the British Pharmacological Society.
  - 2007 Cosmos Magazine Bright Spark Award.
- **Professor Sexton** (convenor with Professor Christopoulos)
  - 4th International Molecular Pharmacology of GPCRs 2007 meeting.
- **Dr Vimesh Avlani**
  - 2007 Addex Prize, 4th International Molecular Pharmacology of GPCRs meeting.
- **Ms Emma van der Westhuizen**
  - 2007 ASCEPT Prize, 4th International Molecular Pharmacology of GPCRs meeting.

**Three-dimensional molecular models of the secretin receptor (collaborative project with Professors Larry Miller and Ruben Abagyan).**
Our research focuses on what happens in the brain and its arteries during cardiovascular disease.

Complex factors regulate blood flow to the brain. A stroke occurs when brain tissue is deprived of blood due to blockage or rupture of a cerebral artery. Cardiovascular disorders such as atherosclerosis, hypertension, diabetes and brain haemorrhages increase the risk of stroke. Important gender differences also seem to exist. Our research focuses on identifying mechanisms that play a role in healthy cerebral arteries and in blood vessel diseases.

In 2007, we studied the biochemical, structural and functional characteristics of cerebral arteries in male and female mice and rats, and how these features differ from arteries found outside the brain. Oxygen radicals appear to play an important role in brain-blood flow regulation under normal (non-disease) conditions. However, when cardiovascular risk factors are present, these radicals can also cause problems in the brain. Therefore, oxygen radicals, and the enzymes that generate them can be beneficial or detrimental depending on the health of the individual. It is important that new anti-oxidant drugs, which prevent or treat stroke, do not interfere with normal regulation of brain blood flow.

In other developments, we have also established a mouse model of ischaemic stroke (where the cerebral artery is blocked, which occurs in approximately 80 per cent of stroke patients). We will be able to test how blood vessel defects lead to stroke, an area currently lacking information and research. If successful, this research may lead to safer and more effective treatments for stroke.

www.med.monash.edu.au/pharmacology/research/cereb-pharm.html
The laboratory studies G-protein coupled receptors and how they signal to and change the activity of cells. This group of receptors are the targets for most drugs used therapeutically today.

Molecules that target adrenoceptors are used to treat heart disease and have potential to treat diabetes and memory disorders. We are interested in finding out how drugs that act at the same receptor can activate different signalling pathways. This will result in the development of new classes of highly selective drugs for the treatment of many diseases.

We also work with relaxin family peptide receptors that are involved in reproduction, tissue remodelling and energy balance. Relaxin reduces tissue fibrosis or scarring that is common in chronic diseases such as heart failure, kidney failure and asthma. We study the signalling mechanisms of these receptors and have added to the understanding of how they produce their effects.

NHMRC Project Grants
- Understanding cell signalling mechanisms activated by relaxin family peptides: targets with therapeutic potential (2007-2009).
- Determinants of binding and activity of G-protein coupled receptors RXFP1 and RXFP2; the receptors for relaxin and INSL3 (2007-2009).

ARC Linkage Grant

Awards and achievements
Dr Dana Hutchinson
- Invited speaker: Molecular Pharmacology of G-protein coupled Receptor conference and IBRO satellite meeting on Brain mechanisms, cognition and behaviour in birds.
- Awards: 2007 ASCEPT sponsorship and 2007 Dean’s Award for Excellence in Research.
We investigate the roles of the cardiovascular hormone angiotensin II – as well as other 'break down' fragments of this molecule – in cardiovascular diseases such as hypertension, atherosclerosis and stroke.

High levels of angiotensin II in the body contribute to human disease. This is because the 'binding site' called the AT1 receptor is over-stimulated. This site can be blocked by a family of drugs called 'sartans', which are used to treat hypertension, heart disease and other cardiovascular complications. However, our current research suggests that stimulation of other binding sites such as the AT2 receptor may also contribute to the therapeutic benefit of sartans.

Also, when angiotensin II is degraded, other 'break down' products may help protect the body from the effects of elevated angiotensin II levels. These smaller angiotensin fragments may in fact act via distinct binding sites such as AT2 receptors.

Thus, our research indicates that there is an increasing degree of complexity of the 'angiotensin system' that regulates cardiovascular function, and novel drugs could be potentially be used to treat these diseases.

NHMRC Project Grant
• Anti-atherosclerotic effects of angiotensin fragments and non-AT1 receptors: Validation as innovative therapeutic targets (2007-2009).

NHF Grant-in Aid

Awards and achievements
Ms Sonja Tesanovic
• Awards: Young Investigator Award, Frontiers in Vascular Medicine conference; and Young Investigator Award, High Blood Pressure Research Council of Australia conference.

Ms Claudia McCarthy
• Young Investigator Award, High Blood Pressure Research Council of Australia conference.
Our group focuses on peptide-based drug design and biomembrane nanotechnology. In collaboration with Associate Professor Patrick Perlmutter (Department of Chemistry), we are developing novel compounds that allow us to exploit the potential of peptides as drugs. We are applying our technology to the development of cancer vaccines (with Dr Tony Purcell, University of Melbourne), and new compounds for the treatment of cardiovascular disease (with Professor Ian Smith).

Our membrane nanotechnology projects involve the development of new methods for membrane protein purification and analysis in the area of Alzheimer’s Disease (with Associate Professor David Small), and new biosensor devices (with Farfield Scientific).

NHMRC Project Grants

ARC Linkage Grants
- New Membrane Chips for Membrane Protein Analysis (2007-2009).

ARC Discovery Grant

Our laboratory is studying the molecular mechanisms of protein aggregation and how these protein aggregates cause a range of devastating neurodegenerative diseases.

Most proteins have no trouble folding quickly and efficiently to their correct function shape. However, an increasing number of diseases, including Alzheimer’s and Huntington’s Disease, are caused by incorrectly folded proteins. We use a range of protein-engineering, biophysical and cellular approaches to understand how misfolding occurs and how it can be prevented.

NHMRC Senior Research Fellowship
- (2007-2011)

ARC Discovery Grant

Transmission electron micrograph (left panel) and X-ray fibre diffraction pattern of polyglutamine repeat protein aggregates (right panel).
Our laboratory studies molecular interactions in immunity and infection, and rational drug design. Our group uses structural biology, including synchrotron radiation, and biophysical approaches as the main research tools.

Our research allows us to understand host recognition and pathogen responses, and apply that knowledge to the design of drugs that enhance or counteract these effects. We collaborate with scientists throughout Australia and are supported by funding from the ARC, NHMRC, ACC and Monash University. Our laboratory is also an integral part of the ARC Centre of Excellence in Structural and Functional Microbial Genomics.

NHMRC Program Grant
• (2007-2011)

NIH RO1 Grant
• (2007-2011)

ARC Linkage Grant
• (2007-2009)

ARC LIEF Grant
• 2007

Awards and achievements
Professor Rossjohn
• 2007 Australian Academy of Science Gottschalk medal; and Commonwealth Health Minister’s Award for Excellence in Health and Medical Research

Ms Fleur Tynan
• Premier’s Commendation for Medical Research

Dr Travis Beddoe
• Joint winner of Vice-Chancellor’s Awards for Excellence in Research by Early Career Researchers

Dr Natalie Borg
• Fresh Science Award

The vascular endothelial cells lining blood vessels express proteases at the cell surface, whose activity can affect blood pressure and vascular function. Protease activity can be altered by inhibitory molecules that can control cardiovascular function and potentially treat cardiovascular disease.

The major aim of our research program is to apply advanced proteomic, structural, cellular and molecular biological technologies in a multidisciplinary approach. This will help us to better understand the role that vascular peptides and enzymes called proteases play in the regulation of cardiovascular function. We are particularly interested in two membrane proteases:

**Endothelin Converting Enzyme (ECE)**
Endothelin regulates blood flow by constricting blood vessels. The production of this molecule depends on the local presence and activity of endothelin converting enzyme, or ECE. We study how ECE is transported to and from the cell surface, where it makes endothelin. We are also collaborating with Professor James Whisstock from the Monash Structural Biology Laboratories, who will help us determine the 3-dimensional structure of ECE. This information may allow the design of ECE specific inhibitors as potential therapeutics.

**Angiotensin Converting Enzyme 2 (ACE2)**
Recently published studies have changed the way we think about the role of angiotensin and angiotensin converting enzyme (ACE) in regulating vascular tone. This new research has uncovered a new and related molecule called ACE2, which we have shown to have increased expression in heart disease and liver failure (hepatitis and cirrhosis). ACE2 is also shed from the cell surface and we have developed a method to measure soluble (shed) ACE2 activity. We are studying the physiological role of ACE2 in health and disease, how ACE2 is shed from the cell surface and the significance of shedding as well as exploring the potential of ACE2 as a biomarker (diagnostic/prognostic) for cardiovascular and/or liver disease.
The Whisstock laboratory focuses on understanding the molecular structure of proteins that are relevant to human disease. We are particularly interested in a family of proteins called proteases. These molecules control key processes in humans such as bleeding, tissue repair and defence against infection. Protease dysfunction can result in diseases, including: cancer, heart disease and brain disorders.

In 2007, we determined the first X-ray crystal structure of Plu-MACPF, a perforin-like protein. Perforin works together with a protease and destroys virally infected and cancerous cells. Our structural studies show that the perforin superfamily is related to bacterial cholesterol-dependent cytolysins (CDCs), a family of proteins that cause tissue destruction in gas gangrene and other diseases. This research shows that humans use CDC-like molecules to defend against infection and cancer, and explains why mutations in perforin result in disease. Our results were published in the journal Science (Rosado et al, 2007).

We have also determined the three-dimensional structure of β2-antiplasmin, a protease inhibitor that controls the breakdown of blood clots. Deficiencies in this protein can result in a serious bleeding disorder. This information may help us develop new treatment approaches for diseases such as thrombosis.

Our laboratory also focuses on brain disorders, where we use a bioinformatic approach to explain why certain proteins contain multiple single amino acid repeats such as the protein that causes Huntington’s disease. In addition, we determined the crystal structure of Glutamic Acid Decarboxylase (GAD), an enzyme that produces the inhibitory neurotransmitter GABA. Abnormal levels of GAD and GABA cause serious movement disorders, and may also predispose individuals to diseases such as depression and schizophrenia. Our structural studies show how GAD regulates GABA levels in the body.

http://research.med.monash.edu.au/whisstock
The laboratory uses a range of techniques to investigate biomolecular interactions and the structural basis of these interactions. In particular, X-ray crystallography, nuclear magnetic resonance and surface plasmon resonance coupled with computational tools are utilised to study a number of molecular systems including:

- The molecular basis of innate immunity (in collaboration with Professor Bryan Williams, Monash Institute of Medical Research; and Professor Jamie Rossjohn, Department of Biochemistry and Molecular Biology).
- Protein/oligonucleotide interactions in human cells that control gene expression (in collaboration with Dr Jackie Wilce, Department of Biochemistry and Molecular Biology; Professor Bryan Williams, Monash Institute of Medical Research; Professor Peter Leedman, Western Australian Institute for Medical Research; Professor Myriam Gorospe, National Institutes of Health, USA).

www.med.monash.edu.au/biochem/staff/wilce-jacqueline.html
Facilities

Monoclonal antibodies are currently amongst the most powerful tools available to biologists for the detection, labelling, isolation, quantification and characterisation of proteins. A lack of monoclonal antibodies continues to be a bottleneck in the expanding understanding of protein function and physiological processes.

Monash Antibody Technologies Facility (MATF) is one of the only high-throughput production facilities in the world offering custom-made, high-affinity monoclonal antibodies. It has been established to provide a global source of reagents for researchers in academia and industry, and to continuously advance proteomics-level technology developments.

Australian researchers will enjoy access to high quality antibodies and new techniques in antibody development.

MATF operates under the direction of Alan Sawyer (Director) and Michael Spiegel (Deputy Director), who have spent a combined 21 years at the European Molecular Biology Laboratory (EMBL). The idea to establish the world's most sophisticated antibody production facility was spearheaded in 2006 by Professor Edwina Cornish, Deputy Vice-Chancellor (Research), who concurrently also recruited Professor Nadia Rosenthal as Founding Director of the Australian Regenerative Medicine Institute (ARMI).

Since June 2007, the unit has undergone a rapid metamorphosis from an empty shell to one of the most modern, fully integrated automation laboratories in the world. The collaborative effort was realised through coordination across many departments at Monash. Generous funding came from DIIRD, NCRIS, ASCC and Monash University.

As well as initiating the complete renovation of the facility, MATF staff have presented the facility to academics and industry leaders around the globe. In September 2007, MATF, together with robotics leader Tecan of Switzerland, organised an inaugural symposium on Automated Systematics Biology, which brought together academic leaders in laboratory automation from Harvard University, Max Planck Institute, EMBL and Monash University.

Biotechnology and pharmaceutical companies have also shown an interest in our facility.

With robotic instrumentation already in place, the facility is expected to open for service in 2008.

For more information contact Mr Alan Sawyer on +61 3 990 58906 or alan.sawyer@med.monash.edu

www.matf.monash.org
Monash Micro Imaging

Monash Micro Imaging (MMI) had a busy year in 2007. We adopted a business plan to provide expanded support through increased staffing levels, and continued to develop as a Faculty core facility.

MMI will be managed from the Clayton site where optical microscopy and electron microscopy laboratories reside, with smaller, new imaging nodes being established at Monash Medical Centre (MMC) and the Alfred Medical Research and Education Precinct (AMREP, Prahran). Node partners include: Southern Clinical School and Monash Institute for Medical Research (MMC Node); and Baker Heart Research Institute, Burnet Institute and Monash Alfred groups (AMREP Node).

The recently established Australian Regenerative Medicine Institute will also partner imaging developments with MMI, and ARMI funding to our facility will help relocate the optical imaging laboratories to Building 75 (STRIP1).

This new development will provide state-of-the-art confocal and fluorescence imaging laboratories, including tissue culture and a dedicated PC2 live cell imaging facility. This expansion will see MMI staffing increase to ten, with several new research and technical positions in Electron Microscopy and Optical Microscopy. During 2007, over 150 staff and postgraduate students used our services at Clayton, and 325 staff and postgraduate students attended MMI training programs.

MMI introduced significantly more powerful imaging software for two and three-dimensional imaging, and established a multidimensional image analysis platform. We have also acquired a high-speed, live cell imaging system and installed a large area imaging microscope for fluorescence and bright field imaging with teleconferencing facilities.

MMI, partnering with the Monash School of Information Technology/e-Research, Department of Biochemistry and Molecular Biology and Leica Microsystems (Germany), received an ARC Linkage Grant to develop a high-throughput grid-based environment for real-time biomedical imaging. MMI also signed access agreements with Southern Health, Leica Biosystems (Australia) and the Australian Stem Cell Centre to provide expertise and access to instrumentation for research and diagnostic imaging.

For more information contact Dr Ian Harper on +61 3 9905 3779 or ian.harper@med.monash.edu.au

www.microimaging.monash.org

For more information about both Proteomics Australia and the Monash Biomedical Proteomics Facility please contact Dr David Steer or Ms Josie Lawrence on +61 3 9905 3779 or david.steer@med.monash.edu.au; josie.lawrence@med.monash.edu.au

www.med.monash.edu.au/biochem/facilities/proteomics

2007 was a very busy and successful year for the Monash Biomedical Proteomics Facility. In 2006, we purchased and took delivery of new instrumentation (micro-Q ToF, Q-trap with ETD and nano-LC), and in 2007 commissioned the equipment and implemented new operating procedures. Now we can not only rapidly identify proteins in solution or from gels but can also quantitate these proteins and examine important post-translational protein modifications such as phosphorylation and glycosylation.

This year, our facility provided proteomic support for the School of Biomedical Sciences and other faculty schools and departments, as well as external academic and commercial collaborators from Australia and overseas.

One exciting development in 2007 was the implementation of the federally-funded National Collaborative Infrastructure Scheme initiative. As part of this funding initiative, Bioplatforms Australia was established. The bioplatforms include: Genomics, Bioinformatics, Metabolomics and Proteomics. The Monash Biomedical Proteomics Facility was chosen as the Victorian node of Proteomics Australia (with other nodes in New South Wales, Queensland and South Australia). This proteomics network allows all Australian researchers the opportunity to access high quality proteomic support at subsided costs.

For more information about both Proteomics Australia and the Monash Biomedical Proteomics Facility please contact Dr David Steer or Ms Josie Lawrence on +61 3 9905 3779 or david.steer@med.monash.edu.au; josie.lawrence@med.monash.edu.au

www.med.monash.edu.au/biochem/facilities/proteomics
Monash Mouseworks

Monash Mouseworks had another busy year in 2007, providing high barrier holding facilities and other technical services to medical researchers in the School of Biomedical Sciences and external researchers.

With an energetic team of staff led by Facility manager Tina Ventura, Mouseworks managed over 100 transgenic mouse colonies. Microinjectionist Tanya Templeton created novel transgenic mice for new and exciting scientific studies.

Monash Mouseworks provides a range of technical services to researchers, including freezing and storing mouse lines, and re-derivation of lines to provide clean mice for scientific studies. The use of fluorescent tags or markers is now common in cell and animal studies. One marker is the green fluorescent protein or GFP which is derived from the jellyfish *Aequorea victoria*. The green fluorescence emitted provides a powerful tool for researchers and provides excellent advantages for mouse breeding facilities such as Mouseworks. Below we can see its usefulness in identifying transgenic mouse pups within a litter of newborn mice.

Monash Mouseworks will continue in 2008 to provide first class management and care of mouse lines, and together with the Monash gene-targeting facility at Monash Institute of Medical Research, provide Monash researchers with the best opportunities to undertake cutting edge, transgenic mouse-based research. In 2008, Mouseworks will be integrated into a University-wide platform of animal services that will improve research productivity at the Clayton campus.

For more information contact Dr Tim Cole on +61 3 990 55753 or tim.cole@med.monash.edu.au

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Protein Production Unit

The Protein Production Unit (PPU), which was established in 2005, provides a dedicated service for commercial and academic research clients.

With our liquid handling robots and our automated high-throughput chromatography system, we can offer various services: protein expression, screening of expression conditions, small scale and large scale protein purification, quality assurance and collaborative research.

In 2007, the PPU began using liquid handling robots to optimise recombinant protein expression conditions. We are also developing protocols that will analyse the effect of additives on the stability of proteins in high-throughput processes. This will allow proteins to be concentrated or stored in buffers that either increase their stability or solubility.

In 2007, over 600 proteins were purified using the unit's novel purification strategies. The majority of these proteins had not been expressed or purified before.

The facility is supported by the ARC Centre of Excellence in Structural and Functional Microbial Genomics, and is operated by Dr Noelene Quinsey and Mr Nik Sotirellis under the direction of Professor Stephen Bottomley.

For more information contact Professor Stephen Bottomley on +61 3 990 53703 or Dr Noelene Quinsey on + 61 3 990 20019, or proteinproduction.biochemistry@med.monash.edu.au

Centres

The ARC Centre of Excellence in Structural and Functional Microbial Genomics brings together a team of internationally-renowned researchers with complementary expertise from the departments of Microbiology, and Biochemistry and Molecular Biology. The Centre conducts integrated research that elucidates key aspects of microbial pathogens and the hosts they infect, focussing on diseases of importance to Australian primary industry. At the core of the Centre’s applied research program is a genomics-based development process, which utilises high-throughput, robotic protein production and analysis to identify and characterise lead candidates for novel vaccines or drug targets.

Major projects include the development of vaccines against leptospirosis, fowl cholera, swine dysentery and avian necrotic enteritis, in collaboration with industry partners: Pfizer Animal Health, Intervet International and the Australian Poultry CRC. In 2007, fundamental research within the Centre into microbial genomics and pathogenesis was published in prestigious scientific journals such as Science, Nature Immunology and Nature Biotechnology.

The Centre also works in partnership with scientists at The University of Sydney, The University of Queensland, CSIRO Livestock Industries, Victorian Bioinformatics Consortium, and the Victorian Partnership for Advanced Computing (VPAC), as well as collaborators in Europe, Asia and America.

The ARC Centre of Excellence in Structural and Functional Microbial Genomics Director, Professor Ben Adler

www.microbialgenomics.net

Centre for Vascular Health

Cardiovascular diseases are the number one cause of death worldwide and affect one in six Australians, or one in four individuals by the age of 50. Treatment often comes too late, resolves some symptoms but does not target the actual cause of disease. We need early diagnosis and mechanism-based drugs to make a difference.

The Monash University Centre for Vascular Health (CVH) unites scientists from diverse disciplines to conduct research and development programs on chip-based diagnostics, whole body imaging approaches, new therapeutic targets and candidate drugs. We aim to achieve early detection, cure and prevention of cardiovascular disease.

The Director of CVH is Professor Harald Schmidt, Head of the Department of Pharmacology, who has built an outstanding international research profile in vascular medicine and translational medicine. The Clinical Director, Professor Barry McGrath is an eminent cardiologist. He heads the Monash University vascular sciences clinical research group. The Chief Scientific Officer is Dr Kirstin Wingler, who has several years of commercial experience in cardiovascular drug development.

We have formed alliances with partner organisations (RMIT University, Bernard O’Brien Institute of Microsurgery) and industry (Servier, Bayer) to ensure that CVH’s research is successfully translated into clinical practice and treatment. We are supervised by a high profile Advisory Committee (lead by Professor Lawrie Beilin, University of Western Australia), an International Scientific Advisory Board (Professor Paul Vanhoutte, University of Hong Kong), and showcase our work on a biannual basis at the Frontiers in Vascular Medicine conference.

Centre for Vascular Health Director, Professor Harald Schmidt

www.cvh.monash.org
Grants and Funding

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<td>$16,416,182</td>
<td>$20,508,628</td>
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<tr>
<td><strong>Total Income</strong></td>
<td>$19,514,321</td>
<td>$22,054,556</td>
<td>$25,676,167</td>
<td>$35,163,642</td>
<td>$39,239,056</td>
<td>$47,378,076</td>
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</table>

Research Income 2007

Research Income 2002 to 2007
## Major Grants Awarded in 2007 (over $100,000)

<table>
<thead>
<tr>
<th>Source</th>
<th>Chief Investigator and Project Title</th>
<th>Duration</th>
<th>Period</th>
<th>Total Funds</th>
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</thead>
<tbody>
<tr>
<td>NHMRC</td>
<td>Beddoe T: A functional and structural approach to understanding Leptospiral host-pathogen interactions.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$483,750</td>
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<tr>
<td>NHMRC</td>
<td>Beddoe T: Structural characterization of novel ABS cytotoxin - SubAB.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$427,125</td>
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<tr>
<td>NHMRC</td>
<td>Beddoe T: Understand the mechanism of action of a food-borne toxin. (CDA)</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$362,000</td>
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<tr>
<td>NHMRC</td>
<td>Bird P: Regulation of leukocyte lifespan by granzyme B and PI-9.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$783,750</td>
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<td>NHMRC</td>
<td>Borg N: Understanding how T cell receptors in our immune system survey foreign lipid antigens. (CDA)</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$362,000</td>
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<tr>
<td>NHMRC</td>
<td>Bourne K: How does the visual brain compensate following damage in early life? (CDA)</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$400,000</td>
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<tr>
<td>NHMRC</td>
<td>Bowser D: Glia-neuronal interactions. (CDA)</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$400,000</td>
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<tr>
<td>NHMRC</td>
<td>Christopoulos A: Research Fellowships.</td>
<td>5 yrs</td>
<td>2008-2012</td>
<td>$596,000</td>
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<tr>
<td>NHMRC</td>
<td>Coppel R: Functional and Structural Studies of a Glycosyltransferase Essential for Complex Glycolipid Biosynthesis in Mycobacteria.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$488,250</td>
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<td>NHMRC</td>
<td>Denton K: Altered renal development programs adult hypertension.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$582,750</td>
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<tr>
<td>NHMRC</td>
<td>Denton K: Interaction between estrogen and the renin-angiotensin system in the regulation of arterial pressure.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$612,750</td>
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<tr>
<td>NHMRC</td>
<td>Denton K: Research Fellowships.</td>
<td>5 yrs</td>
<td>2008-2012</td>
<td>$537,500</td>
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<td>NHMRC</td>
<td>Ferrero R: Bacterial outer membrane vesicles as immunomodulatory agents in Helicobacter pylori infection.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$294,500</td>
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<td>NHMRC</td>
<td>Halls M: Training Fellowship.</td>
<td>4 yrs</td>
<td>2008-2011</td>
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<td>NHMRC</td>
<td>Hooper S: Phase contrast X-ray imaging of the lung at birth.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$498,593</td>
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<td>NHMRC</td>
<td>Hutchinson D: Understanding the mechanisms used by G-protein coupled receptors to regulate insulin-independent glucose transport.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$310,500</td>
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<td>NHMRC</td>
<td>Jans D: Negative regulators of nuclear import; potential links to cancer.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$476,000</td>
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<td>NHMRC</td>
<td>Lang R: Remodelling of pacemaker mechanisms driving ureteric peristalsis during pelviureteric obstruction.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$596,500</td>
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<td>Lui L: Training Fellowship.</td>
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<td>May L: Training Fellowship.</td>
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<td>NHMRC</td>
<td>Mitchell C: Regulation of PtdIns(3,4)P2 signaling by inositol polyphosphate 4-phosphatase-1.</td>
<td>3 yrs</td>
<td>2008-2010</td>
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<td>NHMRC</td>
<td>Parker D: Training Fellowship.</td>
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<td>NHMRC</td>
<td>Parkington H: Control of uterine contraction: role of interstitial cells.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$563,625</td>
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<td>NHMRC</td>
<td>Porter C: Training Fellowship.</td>
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<td>NHMRC</td>
<td>Rosa M: Plasticity of the primate sensory cortex.</td>
<td>3 yrs</td>
<td>2008-2010</td>
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<td>NHMRC</td>
<td>Rossjohn J: An X-ray crystallographic investigation into the adaptive immune response to Epstein Barr Virus.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$501,000</td>
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<td>NHMRC</td>
<td>Sobey C: Does NADPH oxidase link gender, hormone replacement therapy and outcome after stroke?</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$460,500</td>
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<td>NHMRC</td>
<td>Sobey C: Heme-oxidized soluble guanylyl cyclase, a mechanism-based target for vascular diagnostics and vasoprotective therapy.</td>
<td>3 yrs</td>
<td>2008-2010</td>
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<td>NHMRC</td>
<td>Song J: Training Fellowship.</td>
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<td>NHMRC</td>
<td>Stanley E: Derivation of Pancreatic B-cells from Embryonic Stem Cells.</td>
<td>5 yrs</td>
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<td>$2,941,880</td>
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<td>NHMRC</td>
<td>Stanley E: Expansion, Differentiation and Functional Analysis of In Vitro Derived Pdx1+ Pancreatic Progenitors.</td>
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<td>2008-2010</td>
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<td>Summers R: Novel actions of beta-adrenoceptor antagonists: implications for the treatment of cardiac failure.</td>
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<td>NHMRC</td>
<td>Trounson A: Role of Amnion Derived Stem Cells in Reducing Lung Fibrosis.</td>
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<td>2008-2010</td>
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<td>NHMRC</td>
<td>Tynan F: Training Fellowship.</td>
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<td>NHMRC</td>
<td>Walter M: Training Fellowship.</td>
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<td>2008-2011</td>
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<td>NHMRC</td>
<td>Whisstock J: Control of proteases in infectious, degenerative and cardiovascular disease.</td>
<td>5 yrs</td>
<td>2008-2012</td>
<td>$11,09,847</td>
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<td>NHMRC</td>
<td>Whitchurch C: Characterisation of extracellular DNases of Pseudomonas aeruginosa and their contribution to disease.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$401,625</td>
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<td>NHMRC</td>
<td>Whitchurch C: Examination of the role of biofilms in infection with enteropathogenic Escherichia coli.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$438,000</td>
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<tr>
<td>NHMRC</td>
<td>Whitchurch C: Genetic dissection of biofilm development by non-typeable Haemophilus influenzae.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$401,625</td>
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<tr>
<td>Source</td>
<td>Chief Investigator and Project Title</td>
<td>Duration</td>
<td>Period</td>
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<td>---------------------</td>
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<tr>
<td>ARC</td>
<td>Buckle A: Australian High Performance Computational Structural Biology Facility. (LIEF)</td>
<td>1 yr</td>
<td>2008</td>
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<tr>
<td>ARC</td>
<td>Buckle A: Development of high-throughput in silico methods for protein structure determination by X-ray crystallography</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$240,000</td>
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<td>ARC</td>
<td>Dyer A: Colour visual processing by honeybees: solutions for decision making in complex environments.</td>
<td>5 yrs</td>
<td>2008-2012</td>
<td>$586,530</td>
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<td>ARC</td>
<td>Rosa M: Understanding how the primate brain processes visual information.</td>
<td>5 yrs</td>
<td>2008-2012</td>
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<td>Rossjohn J: A structural investigation into the peptide-loading complex molecular machine.</td>
<td>3 yrs</td>
<td>2008-2010</td>
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<td>ARC</td>
<td>Smyth I: The role of palmitoylation in hair follicle and epidermal stem cell biology.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$232,000</td>
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<td>ARC</td>
<td>Stone M: Development and Characterization of Chemokine Receptor Mimics.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$330,000</td>
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<td>ARC</td>
<td>Wilce M: Protein-mRNA interactions and their role in post-transcriptional regulation.</td>
<td>5 yrs</td>
<td>2008-2012</td>
<td>$719,500</td>
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<td>DEST</td>
<td>Boyd R: The establishment of a joint Australia-China centre for excellence in stem cell science.</td>
<td>4 yrs</td>
<td>2008-2011</td>
<td>$454,500</td>
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<td>GlaxoSmithKline</td>
<td>Christopoulos A: Investigating mechanism of action of GPCR allosteric agonists/modulators and assay development.</td>
<td>1 yr</td>
<td>2008</td>
<td>$177,000</td>
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<td>GlaxoSmithKline</td>
<td>Drummond G: Research program to identify new lead compounds as selective inhibitors of NADPH Oxidase.</td>
<td>1 yr</td>
<td>2008</td>
<td>$126,351</td>
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<tr>
<td>Foundation For High Blood Pressure Research Council of Australia</td>
<td>Kemp-Harper B: HNO donors as novel therapies for vascular disease.</td>
<td>2 yrs</td>
<td>2008-2009</td>
<td>$200,000</td>
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<td>National Alliance for Research on Schizophrenia &amp; Depression</td>
<td>Pradeep N: Effects of intranasal oxytocin on amygdala response to fear in Social Anxiety Disorder.</td>
<td>2 yrs</td>
<td>2008-2009</td>
<td>$124,567</td>
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<td>CRC Australian Poultry</td>
<td>Rood J: A new virulence factor in Clostridium perfringens causing Necrotic Enteritis in Chickens: A route vaccine development.</td>
<td>3 yrs</td>
<td>2008-2010</td>
<td>$280,053</td>
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<td>Ian Potter Foundation</td>
<td>Sexton P: High Content Analysis Facility.</td>
<td>1 yr</td>
<td>2008</td>
<td>$250,000</td>
</tr>
</tbody>
</table>
Undergraduate and Postgraduate Coursework Studies

Dr Yvonne Hodgson  
School Teaching Coordinator and Convenor, Bachelor of Biomedical Sciences  
Associate Professor Marilyn Baird  
Head, Department Medical Imaging and Radiation Sciences and Convenor, Bachelor of Radiography and Medical Imaging

Overview of Undergraduate Teaching

The School teaches undergraduate students enrolled in a wide range of bachelors degree courses including: Biomedical Science, Behavioural Neuroscience, Medicine/Surgery, Nutrition and Dietetics, Radiography and Medical Imaging, and Science. In 2007, the School supervised 81 students who were undertaking honours programs in Science and Biomedical Science.

The School also teaches and manages three postgraduate coursework programs: Masters programs in Medical Ultrasound, Radiographic Practice and Medical Radiations. The latter program offers stream-specific study in Nuclear Medicine Science and Radiation Therapy.

In 2007, the Faculty of Medicine, Nursing and Health Sciences was ranked number one in the national Learning and Teaching Performance Fund rankings. While this reflects the performance of the Faculty overall, the School of Biomedical Sciences, as a major player in the Faculty, made a significant contribution to this success.

School Education Committee

Our Education Committee held 11 meetings during 2007. Significant achievements were:

- Development of graduate attributes for Biomedical Science and BSc programs;
- A new third-year structure for the Biomedical Science course, which provides better integration and consolidation of the student learning experience;
- Formation of an Honours group to improve the quality and consistency of experiences and training in each department;
- A new BSc major in Developmental Biology, comprising the study of embryology, anatomy, molecular biology, genetics, stem cells, regenerative medicine and tissue engineering. A new specialisation within the BSc Honours program: Stem Cells and Regenerative Medicine; and
- A new Masters of Medical Radiations (Nuclear Medicine) degree was introduced, a pioneering two year off-campus course that includes 57 weeks of clinical practice. This postgraduate degree comprises study in advanced image processing techniques, new radiopharmaceuticals and the use of innovative cancer-targeting and cancer-killing agents in clinical practice.

Scholar in Residence

The educational activities in the School were energised by the presence of Professor Trevor Anderson from South Africa as our Scholar in Residence in Education. Trevor, an internationally renowned science educator and Head of the Science Education Research Group at the University of KwaZulu-Natal (Pietermaritzburg), gave one seminar and two workshops on education in biomedical sciences during his two-week stay at Monash. Postgraduate students participated in a workshop on assessment, and staff discussed publishing in educational research.
National Forum on Education in Biomedical Sciences

The School hosted the National Forum on Education in Biomedical Sciences, which brought together over 120 educators. Professor Trevor Anderson delivered the keynote address on conceptual learning in biomedical sciences and Michelle Siow and Elaine Yew, from the Republic Polytechnic, Singapore, discussed problem-based learning. The forum was organised by Professor Phillip Nagley, Dr Yvonne Hodgson and Dr Janet Macaulay.

Student Support

The School organised a one-day transition program for first year students and a careers information night for later year students. The School also supported the student-run Biomedical Science Society.

Two issues of the School newsletter were edited by Dr Yvonne Hodgson, and written by Thomas Dillane. The publications, which were distributed to staff and students, profiled young researchers and described trends in teaching and related events.

Biomedical Science Programs

The second cohort of students from Republic Polytechnic, Singapore completed their final year of studies in Biomedical Sciences at Monash. The twinning program between Monash and the Republic Polytechnic attracts the top students from Republic Polytechnic.

Radiography Programs

2007 was another successful year for the Radiography degree program. All 47 students completed the course and secured full-time employment. A broad mix of private radiology and public and private hospital based metropolitan and regional diagnostic imaging departments provided clinical experience to our students.

Prizes and Awards

High-achieving biomedical sciences students were invited to an afternoon tea with the Head of School, Professor Christina Mitchell in September. The students were congratulated on their success.

The Annual Faculty Prizes and Award Ceremony for academic excellence in 2006 was held in April. The top two students from each year in the Bachelor of Biomedical Science course received $200 and the top student from the honours program received $500. Industry and professional bodies continued to support the radiography course and provide at least two prizes of $200 in each year level of the course.
Postgraduate Research

Overview of Research Training

The Faculty of Medicine, Nursing and Health Sciences is the most research intensive faculty at Monash University with regard to both research income and research training. The largest number of Higher Degree by Research (HDR) students are within the School of Biomedical Sciences, and make up approximately 40 per cent of the Faculty's total HDR load for 2007.

Our students are at the forefront of research innovation, and their vital contribution to research is extremely valued. It has been estimated that postgraduate research students are responsible for approximately half of the University's research output.

Scholarship Success

In 2007 the Faculty of Medicine, Nursing and Health Sciences continued to perform strongly in the postgraduate research scholarship round. The School of Biomedical Sciences did particularly well and was successful in obtaining 36 of the total 92 central scholarships awarded to the Faculty. In addition, a number of students were awarded research scholarships from external organisations including NHMRC and the Cancer Council Victoria.

In the 2007 scholarship round, the Faculty's highest ranking student was from the School of Biomedical Sciences.

Student Awards and Prizes

During 2007, several students within the School of Biomedical Sciences were acknowledged for their research performance. Dr Michelle Halls from the Department of Pharmacology was awarded the prestigious Mollie Holman Doctoral Medal for her thesis entitled Characterisation of the signalling pathways of the relaxin family peptide receptors, RXFP1 and RXFP2. This medal is offered to the Faculty's best doctoral thesis from 2007, demonstrating research excellence. The medal is named in honour of Professor Mollie Holman, who has made a long and distinguished contribution to the University and has been a champion of postgraduate education.

Dr Fleur Tynan from the Department of Biochemistry and Molecular Biology was awarded a commendation in the Premier’s Award for Medical Research for her work in the field of protein crystallography. This award is an initiative of the Victorian government designed to recognise the contribution of young scientists to medical research here in Victoria.

The Higher Degree Research (HDR) Experience

The School of Biomedical Sciences seeks to improve the experiences of HDR students through professional development opportunities. In addition to providing a vibrant research environment, all departments within the School have established successful postgraduate research training programs.

Support is available in a range of areas, including travel, conference attendance and training courses. HDR students within the School are encouraged to have diverse interactions, have the opportunity to be trained in different platform technologies, and collaborate across School disciplines. Our vision is to train our HDR students to become the leaders of the future by nurturing their intellectual and professional development.

2007 HDR completions for the School of Biomedical Sciences

**PhD Students**
- Anatomy and Developmental Biology 4
- Biochemistry and Molecular Biology 20
- Medical Imaging and Radiation Sciences 1
- Microbiology 9
- Monash Immunology and Stem Cell Laboratories 3
- Pharmacology 1
- Physiology 7

**PhD Total** 45

**Masters by Research Students**
- Biochemistry and Molecular Biology 2
- Monash Immunology and Stem Cell Laboratories 3
- Physiology 1

**Masters by Research Total** 6

**Total Higher Degrees by Research (HDR)** 51

Dr Fleur Tynan received a commendation in the 2007 Premier's Award for Medical Research.
Resource Managers
The Resource Managers coordinate the provision of administrative support services for the school and school departments.

Administrative teams of varying sizes provide the following services to staff: human resources; building and infrastructure; financial, technical, teaching and student support.

Biomedical Sciences School Office
Dr Yvonne Hodgson
School Teaching Coordinator and Convenor, Bachelor of Biomedical Sciences

Dr Joanne Waring
Student Services Manager

Ms Carlena Carter
Course Administrator

Mr Lawrence Ng
Student Services Officer

The office primarily supports the teaching activities within the school, including: the Bachelor of Biomedical Science, honours and double degree courses, undergraduate and postgraduate programs from the Department of Medical Imaging and Radiation Sciences, and the school’s involvement in the Bachelor of Science.

The staff members facilitate the selection, admission, enrolment and course completion of students in the programs under the auspices of the school.

Animal Ethics Office
Ms Jane McCausland
Animal Ethics Officer

Mr Lee Marquardt
Administrative Assistant

The office supports animal ethics committees and ensures that animal experimentation complies with existing regulations.

Communication and Development Office
Ms Amanda Hamilton
Communication and Development Officer

The office was established in 2005 to raise the profile of biomedical research at the School of Biomedical Sciences. The office is involved in activities including: events, newsletters, reports, brochures, media releases and web development.

Resource Managers
From left to right: Ms Thila Hallock, Mr Alan Hunter (School Accountant), Mr Simon Dermer, Mr Chris Mayberry, Mr Tony Wilton, Mrs Margaret Dooley and Mr Doug McGregor (School Manager).

School Staff
From left to right: Ms Helen Ogilvie, Ms Natalie Seng, Dr Joanne Waring, Ms Vicki Burkitt, Mr Lee Marquardt, Ms Carlena Carter and Dr Yvonne Hodgson. Absent: Ms Amanda Hamilton (maternity leave), Ms Jane McCausland and Mr Lawrence Ng.
Number of publications

Primary: ............................ 368
Book Chapters: .................... 22
Reviews: ............................ 21
Others: ............................. 14
Total: ............................. 425

Key:

- ANT: Anatomy and Cell Biology
- BCH: Biochemistry and Molecular Biology
- MICRO: Microbiology
- MISCL: Monash Immunology and Stem Cell Laboratories
- PHARM: Pharmacology
- PHY: Physiology
- RAD: Medical Imaging and Radiation Services

Primary


Publications


Book Chapters

Al-Hasani, K. and Howden, S., BAC Vectors: From Genomics to Therapeutic Prospects, in Genetic vectors research focus, P.S. Ruzz; Editor. 2007, Nova Publishers: USA. p. 225-241. [MICRO]


Other

Editorial:


Short Communication:


Conference Publication–Full Refereed Paper and Extract of Paper:


Microcommentary:

Preview:

Letter to the Editor:

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<td>Adler, Professor Ben</td>
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<td>Aguilar, Associate Professor Mibel</td>
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<tr>
<td>Armitage, Dr James</td>
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<td>Bernard, Professor Claude</td>
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<td>Bertram, Professor John</td>
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<td>Bird, Associate Professor Phillip</td>
<td>26</td>
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<tr>
<td>Black, Associate Professor Jane</td>
<td>12</td>
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<td>Bottomley, Professor Stephen</td>
<td>46</td>
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<td>Bourne, Dr James</td>
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<td>Bowser, Dr David</td>
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<td>Boyce, Dr John</td>
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<td>Boyd, Professor Richard</td>
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<td>Brown, Dr Russell</td>
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<td>Christopoulos, Professor Arthur</td>
<td>42</td>
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<td>Clarke, Professor Iain</td>
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<td>Cole, Associate Professor Timothy</td>
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<td>Cooke, Associate Professor Brian</td>
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<td>Davies, Professor John</td>
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<tr>
<td>Denton, Associate Professor Kate</td>
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<tr>
<td>Devanish, Professor Rod</td>
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<tr>
<td>Drummond, Dr Grant</td>
<td>40</td>
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<tr>
<td>Dyce, Dr Adrian</td>
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<td>Elefanty, Professor Andrew</td>
<td>23</td>
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<td>Eppel, Dr Gabriela</td>
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<td>Evans, Associate Professor Roger</td>
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<td>Farniro, Dr Richard</td>
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