

*Merry
Christmas*

from the staff and students
of the
Department of Biochemistry
at the
University of Otago



15th December 2011

As 2011 winds down I thought it would be a good time to reflect on the major developments taking place in Biochemistry. This year's summary was penned collaboratively by Bronwyn and me. OK, mostly by Bronwyn, and reflects a sample of the events throughout the year. We appreciate the opportunity to stay in contact with you through this Christmas letter, and were delighted to receive a number of emails from you in response to last year's offering. It's lovely to hear what you've been doing since you left us.

This year as Director of the Webster Centre for Infectious Diseases, I was fortunate to be part of a team that obtained funding for a PC3 laboratory from the University's large equipment fund. The laboratory is housed in a shipping container. It was made in France, shipped here intact, and lifted onto the Microbiology roof by crane. All air that comes in and out of the laboratory is HEPA filtered, allowing researchers to work on real pathogenic organisms rather than non-pathogenic models. This is one of very first PC3 facilities in a New Zealand academic institution.

In April the Biochemistry Department began operating a Next Generation Sequencing service, providing high-throughput sequencing on the Roche GS-FLX and Illumina HiSeq2000 instruments. In September this facility officially became a service provider for New Zealand Genomics Limited (NZGL), offering a cost-effective sequencing option to the New Zealand genomics research community.

Over the Christmas break the first and second year labs on the first floor of the Microbiology building are being gutted and completely refurbished. This is only the second time in their forty years that these labs have been renovated and we're all looking forward to seeing the finished product - we'll try to remember to put photos in next year's newsletter.

While we cannot boast another Rutherford Medal in the Department this year, staff and students have received a number of lesser scientific awards and a Queen's Birthday Honour.

Warren Tate received the Companion of the New Zealand Order of Merit in the Queen's Birthday Honours list. Warren also did the speaking tour of New Zealand that is part and parcel of his last year's Rutherford Medal award, speaking to packed theatres in Nelson, Wanaka, Dunedin, Auckland, Rotorua, Palmerston North and Christchurch.

Catherine Day, Peter Dearden, Liz Duncan, and Kaye Wilson won major awards at the Otago School of Medical Sciences Awards ceremony at the beginning of the year. Catherine Day won the OSMS Distinguished Researcher of the Year, Kaye Wilson won the Distinguished Teaching Fellow, and Peter Dearden and Liz Duncan won the Best Paper of 2010 Award.

Tony Zaharic, the teaching fellow in charge of the first year biochemistry paper, was given a National Tertiary Teaching Award by the Prime Minister, as well as the prestigious Otago Teaching Award, to round off his collection of three Student Teaching Awards.

In the second annual Genetics Otago/Otago School of Medical Sciences poster evening, Rob Day won the Thermo Fisher Ultimate Postdoc award, while in the student categories, Rowan Herridge and Rhessa Budhidarmo took out the Genetics Otago and NZSBMB prizes respectively.

This year it seems as though we have had a constant presence in the media, with Peter Dearden, Julian Eaton-Rye, Warren Tate, and Tony Merriman each featuring in an episode of TVNZ7's science programme "Ever Wondered", and Stephanie Hughes and Warren Tate appearing in segments of Radio NZ National's "Our Changing World".

Russell Poulter appeared in the news, having led a team who sequenced the kiwifruit pathogens that have appeared on vines around the country. PSA was actually confined to kiwifruit vines in the Bay of Plenty and had not spread to the rest of the country as had been feared - a different, non-virulent, bacterium being the cause of leafspots in the South Island and Eastern North Island. Russell has also been awarded two Grand Challenges Exploration grants from the Bill and Melinda Gates Foundation. Both provide opportunities for substantial further funding after preliminary proof of concept.

Parry Guilford received two project grants and Tony Merriman an extension from the HRC, ensuring that their research (on cancer and autoimmune disease respectively) can continue apace, while Catherine Day and Liz Duncan were successful applicants to the Marsden Fund.

Julian Eaton-Rye finished a massive undertaking this year. He has been editing the 34th volume of "Advances in Photosynthesis and Respiration" since 2005. Herding the 76 international contributing authors from 20 different countries has been a Sisyphean task, which is thankfully now over. Anyone interested in purchasing this massive tome can do so at www.springer.com/life+sciences/plant+sciences/book/978-94-007-1578-3.

Most of you will remember Gill Hughes, and at it is with great sadness that we say goodbye to her this year. After forty years working as a technician in one lab or another around the Department (for George Petersen for most of her career, but most recently for Liz Ledgerwood) funding for Gill's services has come to an abrupt end. Although grant-funded staff are constantly aware of the precariousness of their positions, it is none the less a shock to have to farewell a much appreciated member of staff after so many years. We wish her the best of luck in her search for future employment.

Mike Legge has been working between this department and Pathology for the last few years so we haven't seen so much of him, but now we will not see him at all - he retired last month and, with his wife, has retired to the wilds of the West Coast and the great outdoors they both love so much.

We have three new members of academic staff this year. Anita Dunbier and Lynette Brownfield arrived to take up new lecturing positions, and Liz Ledgerwood moved from a research only position to take a half time senior lectureship.

In May the Department held a "Three Minute Thesis" competition under the rules of the University's competition, where Masters and PhD students explained their research in a maximum of three minutes with just one slide and with much encouragement and hilarity from the audience. The winner of this event was Katie Hope, who presented work on her MSc on gene therapy using a sheep model of Batten disease; titled "Cure Batten disease! EWE know I can!" The joint runners up were Meaghan O'Neill (MSc) with "Aphids: not just a pain in your grass" and Sharleen Rae (PhD) with "All you need is a Mouse Brain and a Dream"

The department has become so large that we can no longer all fit into the Reading Room for our traditional Christmas "strawberries and champagne" party; for the past few years we have been using the Alhambra Union Rugby Club rooms over at the North Ground instead. The rooms are large enough to provide plenty of space for socialising, and, on warm days, outdoor sporting activities can be attempted. Tradition has been bent in other ways as well; beer and finger food have joined the strawberries and "champagne" on the party menu; we no longer have a Christmas cake-baking member of staff, so we don't have a cake; and several years ago Warren Tate, when HOD, inaugurated the awarding of small prizes to staff who have been excelling in some way, and students who have had publications during the year.

We hope you enjoyed this summary of our year's events and look forward to hearing from you over the next year.

Email your news to: biochemistry@otago.ac.nz

or

Post your news to : The Secretary, Department of Biochemistry, PO Box 56, Dunedin 9054, New Zealand
and

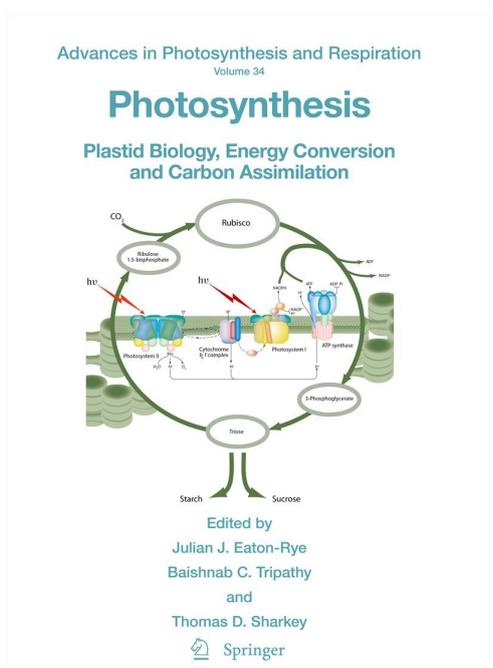
“Like” us at <http://www.facebook.com/Biochemistry.Otago>

Best wishes for Christmas and 2012,

from

Kurt Krause and Bronwyn Carlisle, on behalf of

the Biochemistry staff and students



Julian's book.

2011 Graduations

This year we had sixteen BSc graduates in Biochemistry, thirty-one in Genetics, and two in Plant Biotechnology; two PGDipSci graduates in Biochemistry; one BAppSci graduate; three DipGrad graduates; five BSc(Hons) graduates in Biochemistry and six in Genetics; three MSc graduates in Biochemistry and six in Genetics; and five Biochemistry PhD graduates.



A home brew competition was well attended, with some very impressive beers. Watch out Emersons!



Our students and post-docs did well at the GO/OSMS poster evening. It was held in the new stadium, so we got to check it out (and the Highlanders practising) a bit before the World Cup!



We seemed always to be tripping over microphones and cameras.



And for something completely different, we had to get the exterminators in to deal with a possum that got trapped in the chemical store. The deceased possum spent the following day perched in the reading room rubber plant.



Murray Cockerill turned 65 this year. We have to spoil him to keep him from retiring.



Katie Hope won the Three Minute Thesis competition.



Chelsea (our new purchasing officer, ex receptionist) and Sigurd were amongst those receiving awards from Kurt at the Christmas party

Department Publications for 2011

- Anthony KG, Strych U, Yeung KR, Shoen CS, Perez O, Krause KL, Cynamon MH, Aristoff PA, Koski RA. (2011) "New Classes of Alanine Racemase Inhibitors Identified by High-Throughput Screening Show Antimicrobial Activity against *Mycobacterium tuberculosis*" *PLoS One*. 2011;6(5)
- Baldwin, S.J. *et al.* Association mapping of cold-induced sweetening in potato using historical phenotypic data. *Annals of Applied Biology* 158, 248–256 (2011).
- Bentley, R.W. *et al.* Vitamin D receptor gene polymorphism associated with inflammatory bowel disease in New Zealand males. *Alimentary Pharmacology and Therapeutics* 33, 855–856 (2011).
- Bird, S.D., Legge, M. & Walker, R.J. Thiols stabilize cobblestone morphology of cultured mesothelial cells. *Cell Biol Int* 35, 857–867 (2011).
- Borde, E.C., Ouzegdouh, Y., Ledgerwood, E.C. & Morison, I.M. Congenital Thrombocytopenia and Cytochrome c Mutation: A Matter of Birth and Death. *Semin Thromb Hemost* 37, 664–672 (2011).
- Bricker, T.M., Roose, J.L., Fagerlund, R.D., Frankel, L.K. & Eaton-Rye, J.J. The extrinsic proteins of Photosystem II. *Biochimica et Biophysica Acta - Bioenergetics* (2011).
- Burut-Archanai, S. & Eaton-Rye, J. Na⁺-stimulated phosphate uptake system in *Synechocystis* sp. PCC 6803 with Pst1 as a main transporter. *BMC Microbiology* (2011).
- Chand, A. & Legge, M. Stereological Assessment of Developing Mouse Ovarian Follicles in an *in vitro* Culture System. *Anatomical Record* 294, 379–383 (2011).
- Chand, A.L. & Legge, M. Amino acid transport system L activity in developing mouse ovarian follicles. *Human Reproduction* 26, 3102–3108 (2011).
- Chen-Xu, M. *et al.* Replication of association of the interleukin 23 receptor rs1343151 variant with rheumatoid arthritis in Caucasian sample sets. *Annals of the Rheumatic Diseases* 71, 155–157 (2011).
- Cocheme, H.M. *et al.* Measurement of H₂O₂ within Living *Drosophila* during Aging Using a Ratiometric Mass Spectrometry Probe Targeted to the Mitochondrial Matrix. *Cell Metab* 13, 340–350 (2011).
- Daly, T., Chen, X.S. & Penny, D. How Old Are RNA Networks? *Adv Exp Med Biol* 722, 255–273 (2011).
- Day, R.C. & Beck, C.W. Transdifferentiation from cornea to lens in *Xenopus laevis* depends on BMP signalling and involves upregulation of Wnt signalling. *BMC Dev Biol* 11, (2011).
- Denton, M.J., Kumaramanickavel, G. & Legge, M. Cells as irreducible wholes: the failure of mechanism and the possibility of an organicist revival. *Biology and Philosophy* 1–22 (2011).
- Diaz-Gallo, L.-M. *et al.* Differential association of two PTPN22 coding variants with Crohn's disease and ulcerative colitis. *Inflammatory Bowel Diseases* (2011).
- Dickerhof, N., Kleffmann, T., Jack, R. & McCormick, S. Bacitracin inhibits the reductive activity of protein disulfide isomerase by disulfide bond formation with free cysteines in the substrate-binding domain. *The FEBS journal* (2011).doi:10.1111/j.1742-4658.2011.08119.x
- Dottori, M., Tay, C. & Hughes, S.M. Neural Development in Human Embryonic Stem Cells-Applications of Lentiviral Vectors. *J Cell Biochem* 112, 1955–1962 (2011).
- Draper, R.C., Martin, L.W., Beare, P.A. & Lamont, I.L. Differential proteolysis of sigma regulators controls cell-surface signalling in *Pseudomonas aeruginosa*. *Mol Microbiol* (2011).doi:10.1111/j.1365-2958.2011.07901.x
- Eaton-Rye, J.J. Construction of gene interruptions and gene deletions in the cyanobacterium *Synechocystis* sp. strain PCC 6803. *Methods in molecular biology* (Clifton, N.J.) 684, 295–312 (2011).
- Eaton-Rye, J. Contributions of Govindjee, 1970–1999. *Photosynthesis*

- Ehimen, E.A., Sun, Z.F., Carrington, C.G., Birch, E.J. & Eaton-Rye, J.J. Anaerobic digestion of microalgae residues resulting from the biodiesel production process. *Appl Energ* 88, 3454–3463 (2011).
- Fagerlund, R. & Eaton-Rye, J. The lipoproteins of cyanobacterial photosystem II. *Journal of Photochemistry and Photobiology B: Biology* (2011).
- Feltham, R. *et al.* Smac mimetics activate the E3 ligase activity of cIAP1 protein by promoting RING domain dimerization. *J Biol Chem* 286, 17015–17028 (2011).
- Glubb, D.M. *et al.* NOD2 and ATG16L1 polymorphisms affect monocyte responses in Crohn's disease. *World J Gastroentero* 17, 2829–2837 (2011).
- Hawes, T.C., Marshall, C.J. & Wharton, D.A. Antifreeze proteins in the Antarctic springtail, *Gressittacantha terranova*. *J Comp Physiol B* 181, 713–719 (2011).
- Hazlett, J., Stamp, L.K., Merriman, T., Highton, J. & Hessian, P.A. IL-23R rs11209026 polymorphism modulates IL-17A expression in patients with rheumatoid arthritis. *Genes Immun* (2011).
- Hazlett, J.A. & Legge, M. Scientific Letter The influence of fetal bovine serum on protein expression *in-vitro*: A proteomics approach. *New Zealand Journal of Medical Laboratory Science* 65, 10–11 (2011).
- Hecht, V. *et al.* The pea GIGAS gene is a FLOWERING LOCUS T homolog necessary for graft-transmissible specification of flowering but not for responsiveness to photoperiod. *Plant Cell* 23, 147–161 (2011).
- Herridge, R.P., Day, R.C., Baldwin, S. & Macknight, R.C. Rapid analysis of seed size in *Arabidopsis* for mutant and QTL discovery. *Plant Methods* 7, (2011).
- Hohmann-Marriott, M.F. & Blankenship, R.E. Evolution of Photosynthesis. *Annu Rev Plant Biol* 62, 515–548 (2011).
- Hollis-Moffatt, J.E. *et al.* The SLC2A9 nonsynonymous Arg265 His variant and gout: evidence for a population-specific effect on severity. *Arthritis Res Ther* 13, R85 (2011).
- Hook, S., Phipps-Green, A. & Faiz, F. Smad2: A Candidate Gene for the Murine Autoimmune Diabetes Locus Idd21. 1. *Journal of Clinical Endocrinology and Metabolism*(2011).
- Im, H., Sharpe, M.L., Strych, U., Davlieva, M. & Krause, K.L. The crystal structure of alanine racemase from *Streptococcus pneumoniae*, a target for structure-based drug design. *BMC Microbiology* 11, – (2011).
- Janko, K. *et al.* Multilocus analyses of an Antarctic fish species flock (Teleostei, Notothenioidei, Trematominae): Phylogenetic approach and test of the early-radiation event. *Molecular Phylogenetics and Evolution* 60, 305–316 (2011).
- Jensen, B.P. *et al.* Influence of ABCB1 (P-glycoprotein) haplotypes on nortriptyline pharmacokinetics and nortriptyline-induced postural hypotension in healthy volunteers. *Brit J Clin Pharmacol* (2011).doi:10.1111/j.1365-2125.2011.04126.x
- Kafka, A., Kleffmann, T., Rades, T. & McDowell, A. The application of MALDI TOF MS in biopharmaceutical research. *International Journal of Pharmaceutics* (2011).
- Kalamorz, F. *et al.* Draft Genome Sequence of the Thermoalkaliphilic *Caldalkalibacillus thermarum* Strain TA2.A1. *J Bacteriol* 193, 4290–4291 (2011).
- Kemp, R.A. *et al.* T cell subpopulations in lymph nodes may not be predictive of patient outcome in colorectal cancer. *J Exp Clin Canc Res* 30, – (2011).
- Laurie, R.E. *et al.* The Medicago FLOWERING LOCUS T Homolog, MtFTa1, Is a Key Regulator of Flowering Time. *Plant Physiol* 156, 2207–2224 (2011).
- Legge, M., Jones, L.M. & McLeod, B.J. Energy substrate utilization in the common brushtailed possum (*Trichosurus vulpecula*) using intravenous tolerance tests. *Comparative Biochemistry and Physiology - B Biochemistry and Molecular Biology* 158, 132–135 (2011).
- Linterman, K.S. *et al.* Lentiviral-mediated gene transfer to the sheep brain: implications for gene therapy in Batten disease. *Hum. Gene Ther.* 22, 1011–1020 (2011).

- Liptak, M.D., Fagerlund, R.D., Ledgerwood, E.C., Wilbanks, S.M. & Bren, K.L. The proapoptotic G41S mutation to human cytochrome c alters the heme electronic structure and increases the electron self-exchange rate. *Journal of the American Chemical Society* 133, 1153–1155 (2011).
- Lopez, J. *et al.* CARD-Mediated Autoinhibition of cIAP1's E3 Ligase Activity Suppresses Cell Proliferation and Migration. *Mol Cell* (2011).
- Martin, L., Reid, D. & Sharples, K. *Pseudomonas* siderophores in the sputum of patients with cystic fibrosis. *Biometals* (2011).
- McCowan, L.M.E. *et al.* Paternal contribution to small for gestational age babies: A multicenter prospective study. *Obesity* 19, 1035–1039 (2011).
- Meredith-Jones, K., Waters, D., Legge, M. & Jones, L. Upright water-based exercise to improve cardiovascular and metabolic health: A qualitative review. *Complementary Therapies in Medicine* 19, 93–103 (2011).
- Merriman, G.T.R. & Dalbeth, N. Genetic and environmental risk factors in hyperuricaemia and common gout. *Current Rheumatology Reviews* 7, 114–122 (2011).
- Merriman, T.R. Editorial. *Current Rheumatology Reviews* 7, 94–96 (2011).
- Merriman, T.R. & Dalbeth, N. The genetic basis of hyperuricaemia and gout. *Joint Bone Spine* 78, 35–40 (2011).
- Merriman, T. Population Heterogeneity in the Genetic Control of Serum Urate. *Semin. Nephrol.* (2011).
- Miller, L.D. *et al.* An Iron Regulatory Gene Signature Predicts Outcome in Breast Cancer. *Cancer Res* 71, 6728–6737 (2011).
- Morgan, N.V. *et al.* Mutation in the TCR α subunit constant gene (TRAC) leads to a human immunodeficiency disorder characterized by a lack of TCR $\alpha\beta$ + T cells. *J. Clin. Invest.* 121, 695–702 (2011).
- Nagarajan, A., Winter, R., Eaton-Rye, J. & Burnap, R. A synthetic DNA and fusion PCR approach to the ectopic expression of high levels of the D1 protein of photosystem II in *Synechocystis* sp. PCC 6803. *Journal of Photochemistry and Photobiology B: Biology* (2011).
- Nakatani, Y., Cutfield, S.M., Cowieson, N.P. & Cutfield, J.F. Structure and activity of exo-1,3/1,4- β -glucanase from marine bacterium *Pseudoalteromonas* sp. BB1 showing a novel C-terminal domain. *The FEBS journal* (2011). doi:10.1111/j.1742-4658.2011.08439.x
- Nasser, S., Cunliffe, H.E., Black, M.A. & Kim, S. Context-specific gene regulatory networks subdivide intrinsic subtypes of breast cancer. *BMC Bioinformatics* 12, (2011).
- Nixon, G. *et al.* Streptokinase antibodies in patients presenting with acute coronary syndrome in three rural New Zealand populations. *Journal of Clinical Pathology* 64, 426–429 (2011).
- Panjaworayan, N. and Brown, C.M. Effects of HBV Genetic Variability on RNAi Strategies. *Hepatitis Research and Treatment* (2011).
- Park, S.J., Kleffmann, T. & Hessian, P.A. The G82S Polymorphism Promotes Glycosylation of the Receptor for Advanced Glycation End Products (RAGE) at Asparagine 81 Comparison Of Wild-Type RAGE With The G82s Polymorphic Variant. *J Biol Chem* 286, 21384–21392 (2011).
- Pemberton, C.J. *et al.* Response to letter regarding article, B-type natriuretic peptide signal peptide circulates in human blood: Evaluation as a potential biomarker of cardiac ischemia. *Circulation* 123, (2011).
- Petersen, G. Kenneth Burton. 26 June 1926—22 November 2010. *Biographical Memoirs of Fellows of the Royal Society* (2011).
- Phipps-Green, A. *et al.* Analysis of association of DNASE2 promoter variation with rheumatoid arthritis in European Caucasians. *Annals of the Rheumatic Diseases* (2011).
- Roberts, R.L. *et al.* Association of the protein-tyrosine phosphatase nonreceptor type substrate 1 (PTPNS1) gene with inflammatory bowel disease. *Inflammatory Bowel Diseases* 17, E19–E21 (2011).
- Roberts, R.L. *et al.* Independent replication of an association of CNVR7113.6 with Crohn's disease in caucasians. *Inflammatory Bowel Diseases* (2011). doi:10.1002/ibd.21752
- Roberts, R.L. *et al.* Interaction of the inflammasome genes CARD8 and NLRP3 in abdominal aortic aneurysms. *Atherosclerosis* 218, 123–126 (2011).

- Ryan, M.M., Mason-Parker, S.E., Tate, W.P., Abraham, W.C. & Williams, J.M. Rapidly induced gene networks following induction of long-term potentiation at perforant path synapses *in vivo*. *Hippocampus* 21, 541–553 (2011).
- Seed, P.T. *et al.* Prediction of preeclampsia and delivery of small for gestational age babies based on a combination of clinical risk factors in high-risk women. *Hypertension in Pregnancy* 30, 58–73 (2011).
- Siakkou, E., Rutledge, M.T., Wilbanks, S.M. & Jameson, G.N.L. Correlating crosslink formation with enzymatic activity in cysteine dioxygenase. *Biochimica et biophysica acta* 1814, 2003–2009 (2011).
- Soon, W.W. *et al.* Combined genomic and phenotype screening reveals secretory factor SPINK1 as an invasion and survival factor associated with patient prognosis in breast cancer. *Embo Mol Med* 3, 451–464 (2011).
- Sorrenson, B. *et al.* An ABCA1 truncation shows no dominant negative effect in a familial hypoalphalipoproteinemia pedigree with three ABCA1 mutations. *Biochem Biophys Res Commun* 409, 400–405 (2011).
- Sowerby, S., Mirams, G. & Hill, P. An axisymmetric meniscus converges particles for microscopy. *Journal of Microscopy* (2011).
- Stamp, L.K. & Roberts, R.L. Effect of genetic polymorphisms in the folate pathway on methotrexate therapy in rheumatic diseases. *Pharmacogenomics* 12, 1449–1463 (2011).
- Stevens, S.G., Gardner, P.P. & Brown, C. Two covariance models for iron-responsive elements. *RNA Biol* 8, (2011).
- Suetani, R.J., Sorrenson, B., Tyndall, J.D.A., Williams, M.J.A. & McCormick, S.P.A. Homology modeling and functional testing of an ABCA1 mutation causing Tangier disease. *Atherosclerosis* 218, 404–410 (2011).
- Sutherland, J.E. *et al.* A New Look at an Ancient Order: Generic Revision of the Bangiales (Rhodophyta). *J Phycol* 47, 1131–1151 (2011).
- Tchesnokov, E. & Wilbanks, S. A Strongly Bound High-Spin Iron (II) Coordinates Cysteine and Homo-cysteine in Cysteine Dioxygenase. *Biochemistry* (2011).
- Upritchard, H.G., Yang, J., Bremer, P.J., Lamont, I.L. & McQuillan, A.J. Adsorption of Enterobactin to Metal Oxides and the Role of Siderophores in Bacterial Adhesion to Metals. *Langmuir* 27, 10587–10596 (2011).
- Wilson, M.J., Abbott, H. & Dearden, P.K. The evolution of oocyte patterning in insects: multiple cell-signaling pathways are active during honeybee oogenesis and are likely to play a role in axis patterning. *Evol. Dev.* 13, 127–137 (2011).
- Wilson, M.J. & Dearden, P.K. Diversity in insect axis formation: two orthodenticle genes and hunchback act in anterior patterning and influence dorsoventral organization in the honeybee (*Apis mellifera*). *Development* 138, 3497–3507 (2011).
- Wong, C.K., Young, V.L., Kleffmann, T. & Ward, V.K. Genomic and Proteomic Analysis of Invertebrate Iridovirus Type 9. *Journal of Virology* 85, 7900–7911 (2011).
- Yeoh, C.C., Balcerowicz, M., Laurie, R., Macknight, R. & Putterill, J. Developing a method for customized induction of flowering. *BMC Biotechnology* 11, (2011).
- Zychlinski, von, A., Kleffmann, T., Williams, M.J.A. & McCormick, S.P. Proteomics of Lipoprotein(a) identifies a protein complement associated with response to wounding. *J Proteomics* 74, 2881–2891 (2011).