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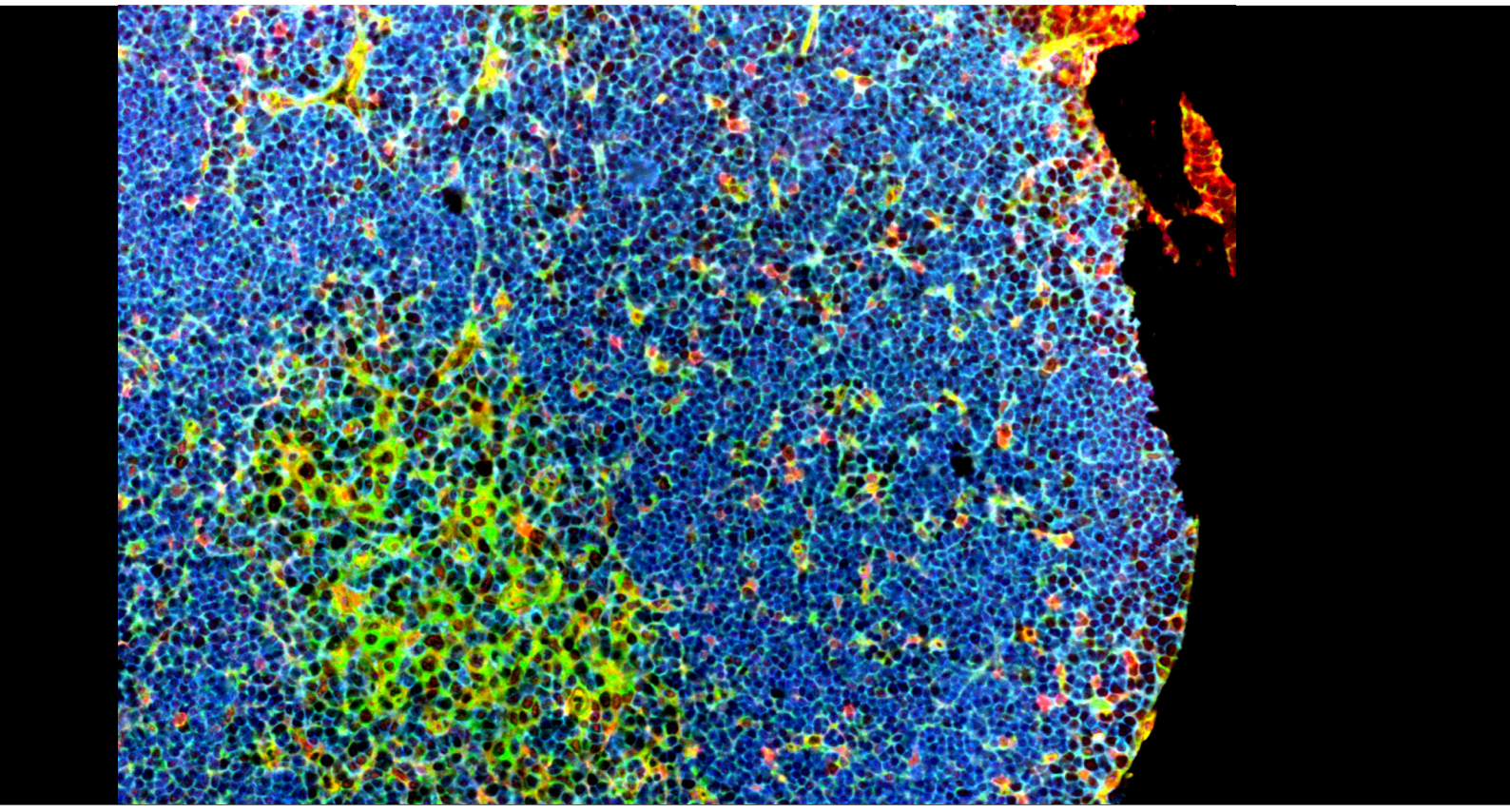

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Seven-colour multiplex staining of the thymus, showing different developmental stages of T cells across the thymic microenvironment. Image credit: Sarah Russell and Amr Allam.

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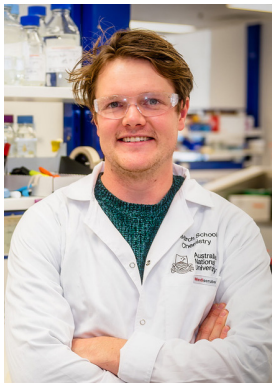

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From the President

Welcome ASBMB members. I live and work on the traditional lands of the Gadigal people of the Eora nation, and recognise their continuing connection to land, waters and culture. I pay our respects to their Elders past, present and emerging, and particularly welcome all First Nations people in our Society. As I take up my new role as President for 2021 and 2022, I want to thank Joel Mackay and the retiring members of the ASBMB Council for their work. Joel remains on the Executive this year as Past President and will be following up on a few initiatives that he began during his term. I am looking forward to working with the current Council – especially Dominic Ng (University of Queensland, Secretary), Marc Kvanskul (La Trobe University, Treasurer) and Tatiana Soares da Costa (La Trobe University, Editor and Chair of Communications), and everybody else who makes this Society function.

It is both a privilege and responsibility to serve as the President of the ASBMB. This year it feels especially daunting in the face of everything that is challenging us as a professional society, as researchers and teachers in institutes and universities, all amid a global pandemic. As the impact of COVID-19 continues into 2021, we continue to face uncertainty. If we are luckier, the uncertainties are about whether we will be getting to any in-person conferences, if we will ever travel again and how many hours we are going to be on Zoom this year. Others have it much tougher, with job and career uncertainties.

I feel like my main role in the next couple of years will be to keep things running, but there is one area that can't wait until this crisis passes. The research funding situation in Australia, particularly when it comes to basic science, ECRs and career pathway continues to dismay most of us. The ASBMB has been increasing involvement in science advocacy, particularly with Science and Technology Australia (STA), in part to try and address this situation. I'd like to hear from ASBMB members, particularly ECRs who are interested in trying to change the situation – especially if you have some ideas to implement but don't feel you have a platform or enough peers to support you.

One of the main functions of the ASBMB is to provide meeting platforms and bring people together from all around the country. This year, some of the Special Interest Groups have been planning a joint event, but with snap lockdowns and borders between states going up and down on a regular basis, planning is necessarily fluid. We'll hear more soon. We're also hoping, following last year's very successful online event, to have an education symposium. It was heartening last year to see everybody sharing idea and tools around switching so suddenly from face-to-face to online teaching. The 22nd FAOBMB Meeting in Christchurch, New Zealand, in late November is still on schedule. The organisers hope for at least a Tasman travel bubble to be open, but are also looking at options for remote attendance as necessary. Our next big onshore meeting is the postponed ComBio2020 meeting, organised by Jackie Wilce and Mark Hulett, now the ComBio2022 meeting to be held in Melbourne in late September 2022. We also have the IUBMB Congress being held in Melbourne in 2024, organised by Leann Tilley.

One of ASBMB's focuses is to recognise members at all career stages for their achievements in research, education and community support through prizes and fellowships. Remember that you need to be a member of reasonable standing to nominate and receive awards. Congratulations to all our current awardees – you can read about them in this issue of the *Australian Biochemist*.

Jacqui Matthews
President, ASBMB

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FAOBMB 2021

16th FAOBMB Congress
CHRISTCHURCH, NEW ZEALAND

16th Congress of the Federation of Asian and Oceanian Biochemists and Molecular Biologists

Kia ora

A/Prof Wayne Patrick
CONGRESS CHAIR

Programme planning is well underway for our November Congress, with registrations and the call for abstracts opening in March. Read on for our first tranche of plenary speakers!

We look forward to welcoming Australian Society for Biochemistry and Molecular Biology members to be a valuable part of our Congress.

Key Dates

CALL FOR ABSTRACTS **OPENING** **March 2021**

REGISTRATIONS **OPENING** **March 2021**

CALL FOR ABSTRACTS **CLOSES** **13 August 2021**

EARLY BIRD REGISTRATION **CLOSES** **24 September 2021**

Plenary Speakers

Six life science Societies from New Zealand and Australia are partnering to deliver a diverse programme – from molecules to organisms, big and small. We are excited to name a few of our plenary speakers:

Dame Anne Salmond

Distinguished Professor of Māori Studies and Anthropology, University of Auckland, and thought leader on ways of thinking and living, past and present.

Dr Emily Leproust

CEO, Co-founder and Director of Twist Bioscience, San Francisco, California.

Prof Ron Milo

Professor in the Department of Plant and Environmental Sciences, Weizmann Institute of Science, Israel. The Charles and Louise Gartner professional chair.

Prof Rommie Amaro

Distinguished Professor in Theoretical and Computational Chemistry at the Department of Chemistry and Biochemistry, University of California, San Diego.

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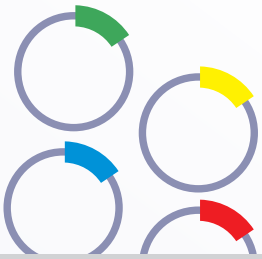

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Publications with Impact

Publications with Impact profiles recent, high impact publications by ASBMB members. These short summaries showcase some of the latest research by presenting the work in a brief but accessible manner. If your work has recently been published in a high profile journal, please email editor@asbmb.org.au.

Taking a Good Look at the NuRD in Us All

Low JKK*, Silva APG, Sharifi Tabar M, Torrado M, Webb SR, Parker BL, Sana M, Smits C, Schmidberger JW, Brillault L, Jackman MJ, Williams DC Jr, Blobel GA, Hake SB, Shepherd NE, Landsberg MJ*, Mackay JP*. The nucleosome remodeling and deacetylase complex has an asymmetric, dynamic, and modular architecture. *Cell Rep* 2020;33(9):108450.
***Corresponding authors: jason.low@sydney.edu.au, m.landsberg@uq.edu.au, joel.mackay@sydney.edu.au**

Stand aside Odysseus (and Paul Hogan).

That's not an odyssey – **this** *is an odyssey…*

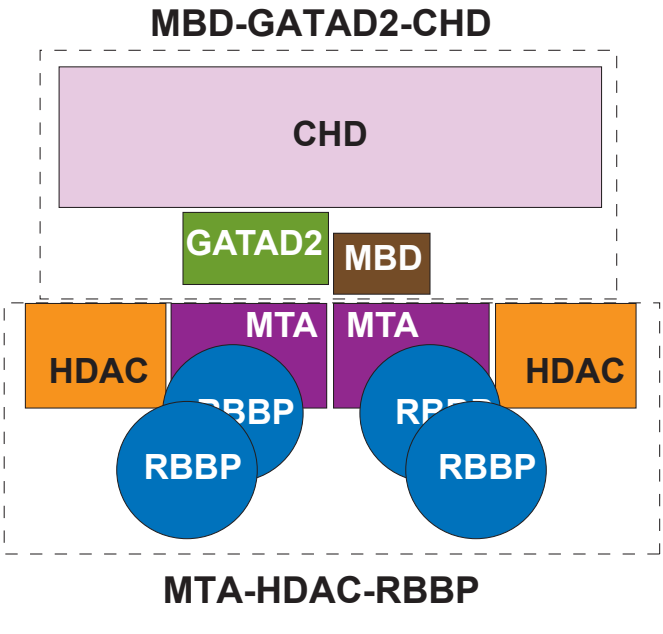
As always in the Mackay lab, it started with zinc fingers. Way back in the mists of time, PhD student Belinda Sharpe was trying to understand the structure of a previously undescribed class of zinc fingers. Although some poor construct choices (by the boss, as usual) led to determination of a completely incorrect (but serendipitously very well-ordered) structure – that we somehow managed to salvage (story for another time) – Ann Kwan and Robyn Mansfield followed up by looking at examples of this zinc finger domain from a chromatin remodelling enzyme called CHD4. Through that work, and through a longstanding collaboration with Gerd Blobel (Childrens Hospital of Philadelphia) on gene regulation, we became interested in the nucleosome remodelling and deacetylase (NuRD) complex – the behemoth that contains CHD4 as one of its subunits.

In 2005, the Blobel lab showed that the transcriptional regulator FOG1 (naturally a zinc finger protein) bound to the approximately 1-MDa NuRD complex to mediate transcription repression. It bound so well that you could put a short peptide from FOG on beads and pull down endogenous NuRD complex from mammalian cells – in a spectacularly pure form. This one-step purification of the complex tickled our structural biologist tummies and we decided to take the plunge and investigate this enigmatic complex further.

Alas, the complex and its subunits proved to be very difficult to work with (for a lab raised on a diet of 10 kDa or less proteins) and refractive to expression in bacteria. In collaboration with the Ernest Laue's lab, we had our first structural breakthrough in 2010. Using proteins expressed in insect cells, Sock Yue Thong solved the structure of a FOG1 peptide bound to RBBP4, a NuRD subunit. Soon after (well, three years), Saad Alqarni published the structure of RBBP with a small portion of MTA1 in 2014, starting to build a picture of the complex.

Despite these small advances, we realised that we knew woefully little about the complex. Apart from the lack of structural information, we didn't know how the subunits fitted together and even the subunit stoichiometry was controversial. At about this point, we decided that reductionism wasn't going to get us there – we had to go all or nothing: the whole complex purified from mammalian cells. This was ***way*** out of our comfort zone.

So, Ana Silva, Sarah Webb and Jason Schmidberger rolled up their collective sleeves in collaboration with Michael Landsberg at the University of Queensland to examine the structure using then state-of-the-art negative-stained single particle electron microscopy. Expression and purification protocols (always a critical bottleneck) were established by Sarah, Nicholas Shepherd and Hinnerk Saathoff. At one point, the lab was growing and harvesting 6 L of mammalian cells every four days to produce enough native NuRD complex to feed hungry experiments! Jason, with Benjamin Parker and Mehdi Sharifi-Tabar, used quantitative mass spectrometry to put the question of stoichiometry to rest, and also brought in crosslinking mass spectrometry (XLMS) to provide distance restraints with the hope



A schematic of the NuRD complex architecture.

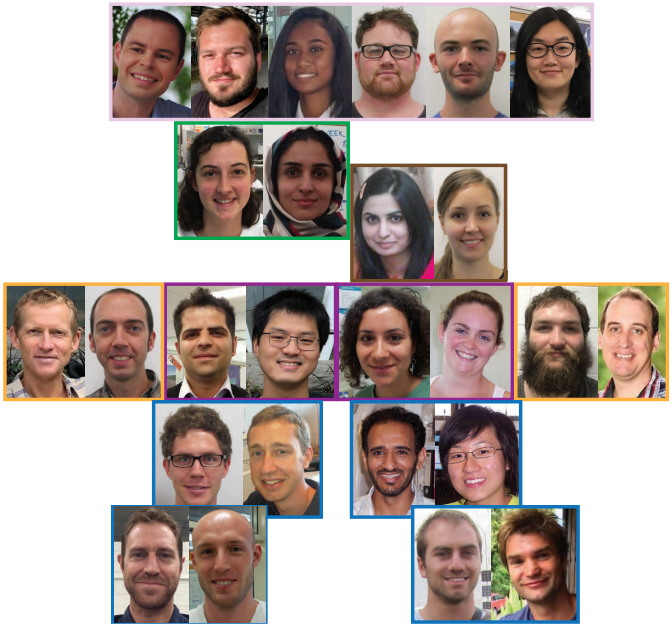
to model the complex within the SPEM envelope. Additional subunit interactions were also identified in a project led by Mario Torrado.

We had competition from labs in the UK. We had a close call in 2016, when we heard that a portion of our work was going to be scooped by the Schwabe lab in Leicester, UK. With their blessing and help to slightly delay their publication, we jumped into high gear, wrote up a manuscript in a week and published that portion of our work in *Protein Science* one day after they published theirs. *Protein Science* were incredibly responsive to the situation when we explained it – they reviewed and handled the manuscript in record time. We have had another similar experience with them recently – and can highly recommend the journal.

By 2018, and with the constant threat of (friendly) competitors, we felt that our main structural work was ready. However, the next two years saw multiple submissions, rejections and appeals (and weeping). The recurring sticking point? Our negative-stained SPEM work was not cryo-EM. The project had spanned the resolution revolution so we'd gotten caught on the wrong side; even though we had the first images of mammalian NuRD, they didn't cut the mustard any more.

Finally, when we were inches away from just sending it to the *Journal of the British Goat Society* (which Joel has always wanted to publish in), we were lucky enough to get a very unreasonable reviewer. Lucky because their intransigence meant that the editor of *Cell Reports* put their review to one side in the end and handed us the golden ticket (after a record number of rounds of copy editing and related tweaks).

It has been by a long way the most epic manuscript experience we have ever had. Now, we just need a poet to knock up a version in verse and it will be up there with Homer… any takers?



The NuRDy team. Featuring contributors to the NuRD structure story since 2010. From the top, left to right Callum Smits, Efe Isilak, Chayenne Ghazi, Courtney Winning, Max Bedward, Jia Wang, Natasha Jones, Hakimeh Moghaddas Sani, Maryam Sana, Ida Nyqvist, Joel Mackay, Mario Torrado, Mehdi Sharifi Tabar, Jason Low, Ana Silva, Sarah Webb, Matthew Jackman, Michael Landsberg, Hinnerk Saathoff, Nicholas Shepherd, Saad Alqarni, Sock Yue Thong, Jason Schmidberger, Mattias Brofelth, Benjamin Parker and Lou Brillault.

We have highlighted the names of many of the players involved in the project, but there were many more who contributed to whom we are extremely grateful.

Jason Low and Joel Mackay
School of Life and Environmental Sciences
University of Sydney

A New Signalling Platform for Developing T Cells

Allam AH, Charnley M, Pham K, Russell SM*. Developing T cells form an immunological synapse for passage through the β-selection checkpoint. *J Cell Biol* 2021;220(3):e201908108.
***Corresponding author: sarah.russell@petermac.org**

T cell development takes place in the thymus, where the thymic microenvironment provides developing T cells with essential cues required for their development and maturation. As T cells migrate across the thymus, they are required to bypass a number of stringent critical checkpoints (**Fig. 1**). T cells which fulfil the requirements of each checkpoint passes to the next checkpoint and eventually mature T cells are released into the blood stream, while T cells that are unable to meet the requirements at each checkpoint trigger programmed cell death.

The beta-selection checkpoint is the first checkpoint developing T cells encounter. At this checkpoint, T cells undergo DNA genomic recombination to produce a functional TCR-beta chain. In its turn, the nascent TCR-beta chain forms a complex with pre-TCR alpha chain, the pre-TCR complex/receptor. Passage through the beta-selection stage is mediated via signalling through the pre-TCR complex. The pre-TCR downstream signalling is not a mere step at the beta-selection checkpoint, but rather the key step in the transition beyond this critical checkpoint. There has been extensive research over the

Publications with Impact

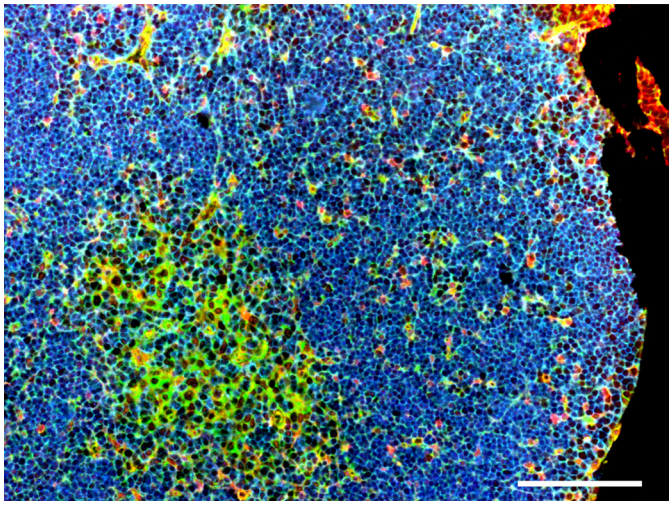


Fig. 1. *Seven-colour multiplex staining of the thymus, showing different developmental stages of T cells across the thymic microenvironment. Scale bar: 50 μm.*

last 20 years that have provided insights into the pre-TCR structural components and downstream signalling effectors. However, signalling initiation, regulators and spatiotemporal characteristics of this pivotal complex remain poorly understood.

In this study, we show that the pre-TCR establishes an immunological synapse (**Fig. 2**), which acts as signalling platform and promotes transition beyond the beta-selection checkpoint. These findings are surprising in part because unlike the immunological synapse of mature T cells, which requires TCR-MHC engagement to trigger its formation and signalling, the pre-TCR was previously thought to signal in a ligand-independent manner. We then asked the question, what regulates the establishment of this immunological synapse? Hence, we directed our attention to two key signalling molecules at the beta-selection, Notch and CXCR4. We found that signalling from both Notch and CXCR4 provide the pre-TCR complex with essential cues that enable the establishment of the immunological synapse. Indeed, inhibition of either Notch or CXC4 signalling disrupted the establishment of the pre-TCR immunological synapse and rendered developing T cells unable to transit beyond the beta-selection checkpoint. In addition, we show that MHC might be involved in triggering the establishment of the pre-TCR immunological synapse and, accordingly, the T cell repertoire.

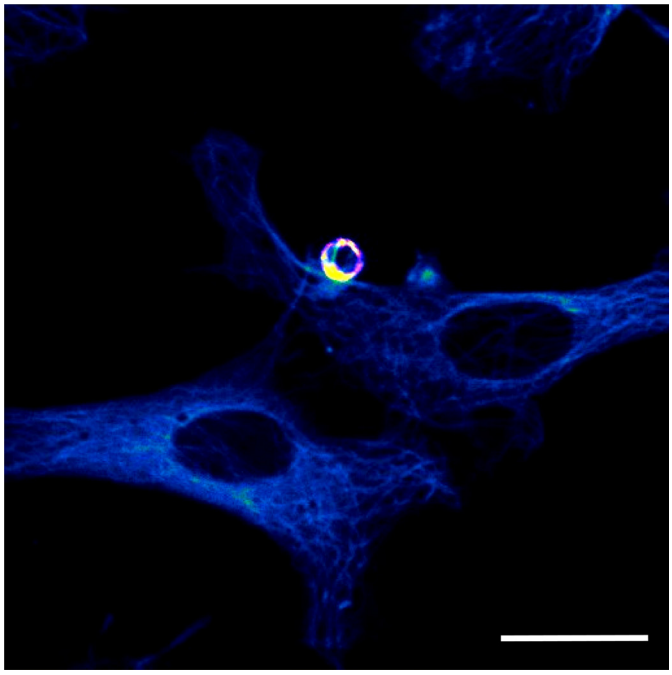


Fig. 2. *A developing T cell (magenta) docking onto stromal cell (blue) and establishing an immunological synapse (yellow). Scale bar: 20 μm.*

These findings build on the growing evidence that the pre-TCR can recognise antigens and overturn the long-held misconception about its autonomous activation. Indeed, just as our paper was accepted for publication, a paper was published showing that the pre-TCR does sample self-ligands (1), complementing our findings. Importantly, knowing that the assembly of the pre-TCR immunological synapse and its capacity for antigen recognition have a significant impact on the T cell repertoire, will help to improve the methodologies and approaches used in lab-generated T cells.

Reference

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Amr Allam.

Amr Allam and Sarah Russell
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Department of Pathology, University of Melbourne;
Sir Peter MacCallum Department of Oncology, University of Melbourne.
Current affiliations:
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Olivia Newton-John Cancer Research Institute.

Identification of Novel Targeted Therapies for PTEN Mutant Breast Cancer

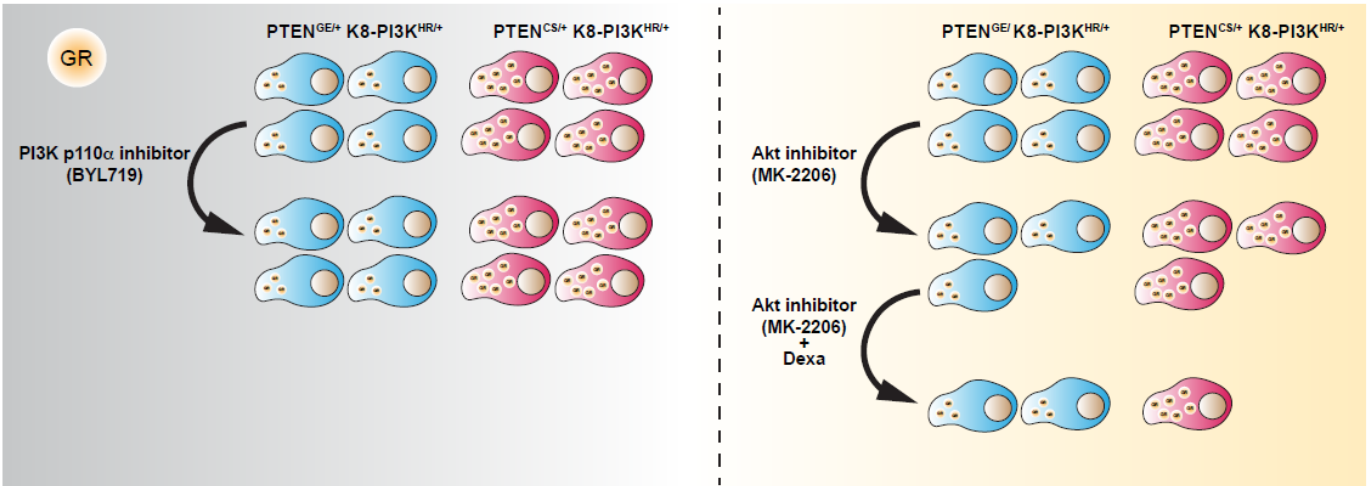
Yip HYK, Chee A, Ang CS, Shin SY, Ooms LM, Mohammadi Z, Phillips WA, Daly RJ, Cole TJ, Bronson RT, Nguyen LK, Tiganis T, Hobbs RM, McLean CA, Mitchell CA, Papa A*.
Control of glucocorticoid receptor levels by PTEN establishes a failsafe mechanism for tumor suppression. *Mol Cell* 2020;80(2):279–295.e8.
***Corresponding author: antonella.papa@monash.edu**

Constitutive activation of the PI3K pathway occurs in approximately 70% of breast cancer cases, often due to mutations in two key members of the pathway: the proto-oncogene PI3K and the tumour suppressor phosphatase PTEN. Activating mutations in the PI3K gene *PIK3CA* occur in up to 40% of estrogen receptor positive (ER+) luminal breast cancers, while *PTEN* genetic alterations happen in both luminal (about 15%) and basal cancer subtypes (about 30%).

Over the last decade, multiple animal models have been developed to define the contribution of these two genes to breast tumour development, however, the impact of PTEN and PI3K compound alterations, which occur in about 10% of cases, was never established. In addition, the selected loss of PTEN function has been reported as one of the mechanisms driving resistance to PI3K-directed targeted therapies, thus demanding identification of novel treatments for breast cancer harbouring PI3K plus PTEN oncogenic mutations.

To address these issues, we have used a mouse model expressing the conditional *PIK3CA* H1047R hotspot mutation, induced by the tamoxifen-driven Cre recombinase under the cytokeratin 8 (K8)-promoter (i.e. K8-PI3K$^{H1047R/+}$), and crossed it with two knock-in mice expressing two independent loss-of-function and cancer associated PTEN mutations: **1.** the PTEN G129E mutation, which inhibits PTEN lipid-phosphatase function towards the second messenger PtdIns(3,4,5)P3; and **2.** the PTEN C124S mutation, which affects PTEN lipid-and-protein phosphatase activity, a.k.a. PTEN phosphatase dead. In our *in vivo* studies, we found that constitutive PI3K activation combined with loss of PTEN lipid-phosphatase function leads to rapid mammary tumourigenesis, which progresses to advanced-stage disease in three months, and significantly reduces overall survival of compound mutant mice relative to single mutant mice. We have also found that the proto-oncogene AKT, a well-established downstream target of PTEN and PI3K catalytic activities, is hyper-active in mammary tumour tissues and human breast cancer cell lines with compound PTEN and PI3K mutations relative to controls. Furthermore, AKT inhibition suppresses growth of PTEN and PI3K mutant mammary organoids, thus indicating AKT as a promising target for the treatment of PTEN and PI3K mutant breast cancer.

In surprising findings, we discovered that mammary tumours developing in PI3K plus PTEN phosphatase-dead mutant mice (i.e. K8-PI3K$^{H1047R/+}$/PTEN$^{C124S/+}$ mice) display a more pronounced cell death phenotype and increased apoptotic response than tumours from mutant



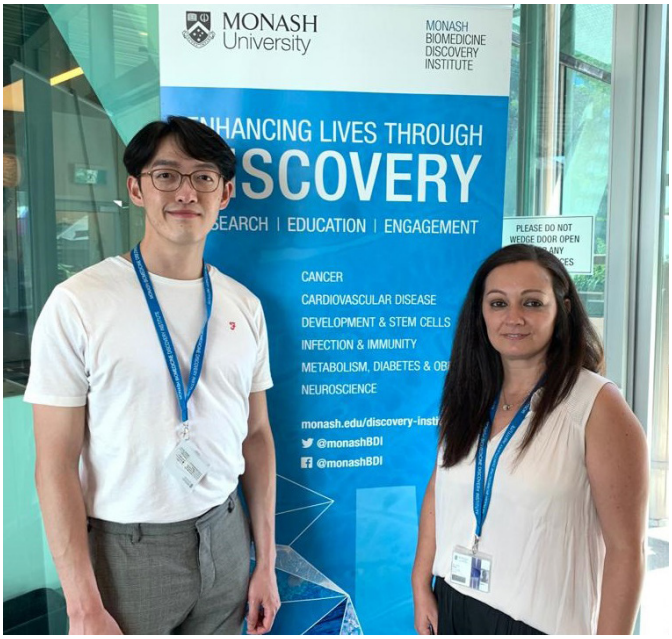
Cancer-associated PI3K and PTEN missense mutations lead to aggressive mammary tumours and resistance to PI3K-based therapies (i.e. BYL719). Targeted AKT inhibition suppresses growth of PI3K plus PTEN lipid-phosphatase dead mammary organoids (i.e. PTEN G129E mutation), and GR activation, through dexamethasone (dexa) administration, further suppresses growth of cells with loss of PTEN lipid-and-protein phosphatase activity (i.e. PTEN C124S mutation).

Publications with Impact

PI3K with PTEN lipid-dead only mice (i.e. K8-PI3K$^{H1047R/+}$/PTEN$^{G129E/+}$ mice). Through phosphoproteomics screening and *ex-vivo* RNA-seq analyses, we identified the glucocorticoid receptor GR as a novel target of PTEN protein-phosphatase function and showed that GR activation through administration of the GR agonist dexamethasone increases death of PTEN C124S mammary organoids compared to PTEN G129E cells. Moreover, GR knock-down increases the proliferative capacity and rescues the cell death phenotype driven by the loss of PTEN protein phosphatase function.

Finally, to test the clinical significance of our findings we treated PI3K and PTEN mutant mammary organoids with the AKT inhibitor MK-2206 in combination with dexamethasone and found that this therapy better suppressed growth of compound mutant cells than single treatments alone. Moreover, PTEN C124S cells better responded to the treatment than PTEN G129E mutant cells.

Collectively, we conclude that cancers with complete functional loss of PTEN (lipid and protein phosphatase activity) harbour a new and unexpected vulnerability that can be exploited for cancer treatment; in that, GR activation combined with targeted AKT inhibition can provide a new and effective therapeutic option for the treatment of PTEN and PI3K mutant breast cancer.



Kelvin Yip and Antonella Papa.

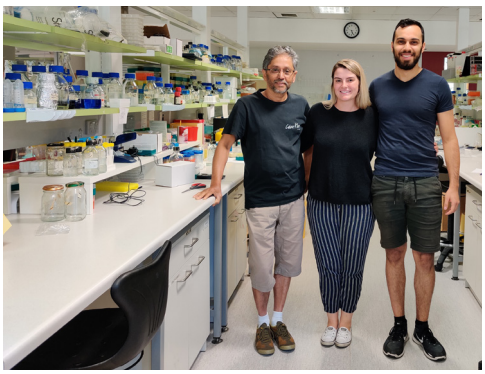
Kelvin Yip and Antonella Papa
Monash Biomedicine Discovery Institute
Monash University

Regulation of Polymicrobial Sepsis by Treml4

Nedeva C, Menassa J, Duan M, Liu C, Doerflinger M, Kueh AJ, Herold MJ, Fonseka P, Phan TK, Faou P, Rajapaksha H, Chen W, Hulett MD, Puthalakath H*. TREML4 receptor regulates inflammation and innate immune cell death during polymicrobial sepsis. *Nat Immunol* 2020;21(12):1585–1596.
***Corresponding author: h.puthalakath@latrobe.edu.au**

Sepsis kills about 11 million people worldwide, of which one third are newborns. It kills more than 7,000 Australians every year, which is more people than breast cancer, prostate cancer and HIV/AID put together. Currently, sepsis therapy is mainly limited to measures directed at its infectious causes (e.g. antibiotics, surgical and supportive therapies) rather than modifying the pathophysiologic processes responsible for its initiation and progression. So far, most of single-hit therapeutic strategies have failed. Despite appearing as ideal targets, inhibition of early inflammatory mediators (TNF-alpha and IL-1) showed no efficacy in clinical trials. Our study has identified the receptor responsible for the inflammatory phase as well as the immune suppression phase of sepsis. Developing blocking antibodies against the human homologue(s) of this receptor has huge therapeutic implications.

Sepsis is the condition of overwhelming systemic microbial infection in which there is widespread organ damage, frequently leading to a downward spiral and death. There is no effective treatment for sepsis today other than intensive care and antibiotic therapy, which leaves patients immunosuppressed and vulnerable to nosocomial infections. There is now abundant evidence that most of the deleterious effects of sepsis are due to host responses rather than the microbes, suggesting that modifying the host response may provide a route to therapy.



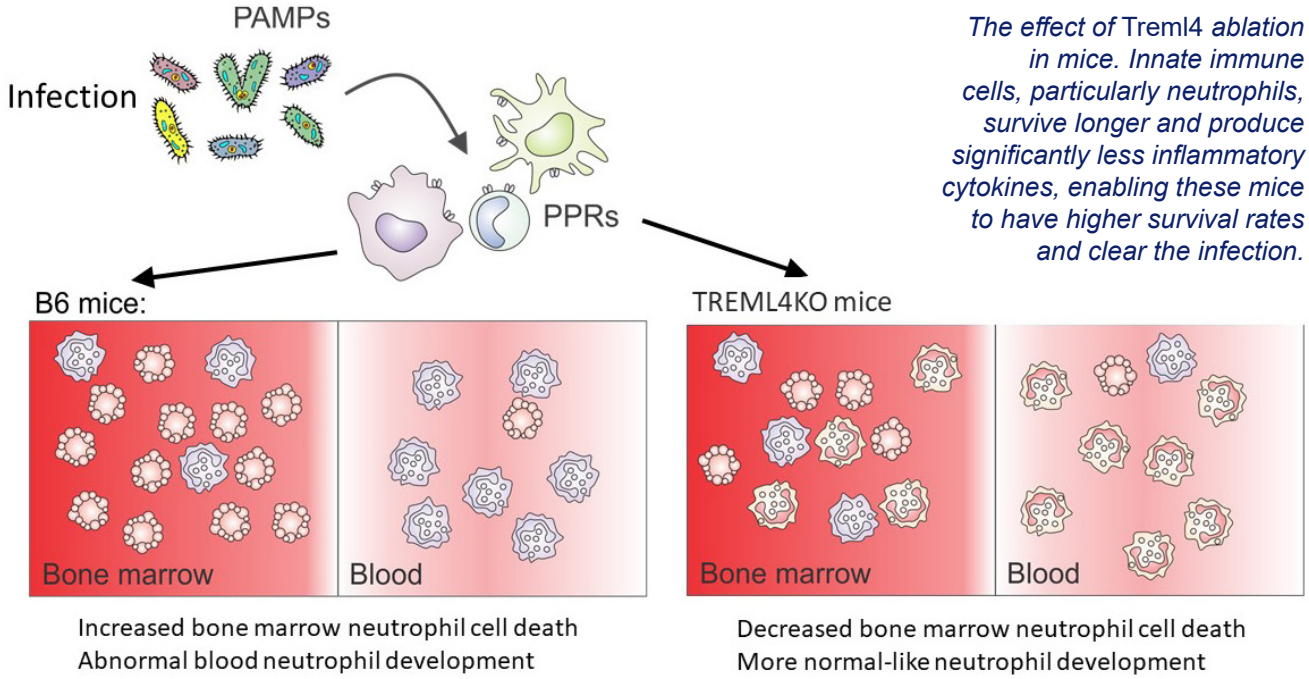
From left: Hamsa Puthalakath, Christina Nedeva and Joseph Menassa.

Publications with Impact

Dysfunctional expansion of hematopoietic stem cells and a block in myelopoiesis are characteristics of lethal sepsis, largely attributed to apoptotic cell death. We hypothesised that the apoptotic response might be ablated by deletion of specific host gene(s). To identify the gene(s) involved, we performed a reconstitution experiment combined with a genome-wide CRISPR screening in mice and identified Trigger Receptor Expressed in Myeloid-like 4 (TREML4) as the master regulator of both inflammation and apoptotic death of innate immune cells including neutrophils and macrophages. Genetic ablation of *Treml4* in mice resulted in almost an absolute protection against both the acute phase and chronic *Pseudomonas* infection. Though in the knockout mice, thymic atrophy (observed in neonatal sepsis) was blocked, mature lymphocytes underwent apoptosis similar to wildtype littermates, suggesting that the adaptive immune system has little role in sepsis pathology. This is consistent with the rapid progression of sepsis and the role innate immunity plays in clearing the infection. It is generally believed that the PAMP receptor TLR4 is the main regulator of inflammation (which was the basis of some of the previous therapeutic trials), but our results also show that TREML4 has a much more significant role in the inflammatory process that TLR4.

Recently, we also have identified the human homologues of mouse TREML4 and it is hoped that developing blocking monoclonal antibodies against these proteins may lead to much-needed therapies for treating polymicrobial sepsis.

Hamsa Puthalakath
La Trobe Institute for Molecular Science,
La Trobe University



The effect of Treml4 *ablation in mice. Innate immune cells, particularly neutrophils, survive longer and produce significantly less inflammatory cytokines, enabling these mice to have higher survival rates and clear the infection.*

A New Approach to Treating Mesothelioma?

Arulananda S, O'Brien M, Evangelista M, Harris TJ, Steinohrt NS, Jenkins LJ, Walkiewicz M, O'Donoghue RJJ, Poh AR, Thapa B, Williams DS, Leong T, Mariadason JM, Li X, Cebon J, Lee EF*, John T*, Fairlie WD*. BCL-XL is an actionable target for treatment of malignant pleural mesothelioma. *Cell Death Discov* 2020;6:114.
***Corresponding authors: erinna.lee@latrobe.edu.au, tom.john@petermac.org, doug.fairlie@onjcri.org.au**

Malignant pleural mesothelioma (MPM) is one of the deadliest of all cancers, with an average patient survival of just 12 months. Platinum-based chemotherapy is still the mainstay of treatment, though some recent reports have indicated that immunotherapy can be beneficial for certain disease subtypes. As resistance to chemotherapy drugs is often associated with defective signalling by the BCL-2-regulated apoptotic pathway, our team at the Olivia Newton-John Cancer Research Institute (ONJCRI), Austin Health and La Trobe University, investigated whether drugs targeting these proteins could be effective in killing MPM cells. Our data showed that one BCL-2 family member, BCL-XL, is particularly important for MPM cell survival and drugs against it are efficacious *in vitro* and *in vivo*.

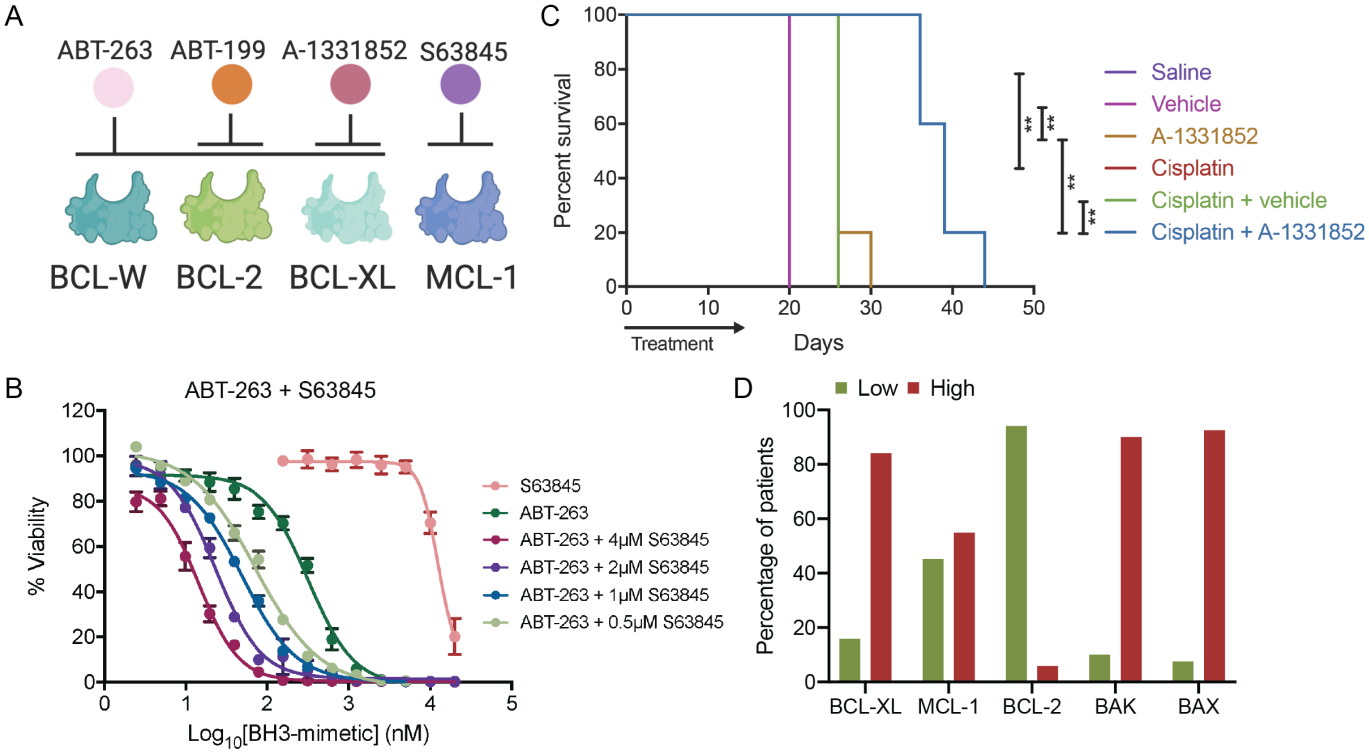


Fig. 1

A. *BH3-mimetic drugs used in this study and their binding specificities (created with Biorender.com).*

B. *Representative data showing ABT-263 is able to kill mesothelioma cells more potently than S63845 but the activity is significantly enhanced if the drugs are combined.*

C. *BCL-XL inhibitors such A-1331852 extend survival of mice transplanted with MPM xenografts, and this is further increased when combined with cisplatin.*

D. *BCL-XL and MCL-1 are the dominantly expressed pro-survival protein in MPM patients.*

Mesothelioma is a cancer of the tissues lining the lungs. It is almost exclusively caused by asbestos fibres. Although asbestos is banned in most Western countries due to its direct link with the disease, it continues to be used in many industrialising countries, whilst many cases in countries like Australia continue to be diagnosed due to exposures associated with home renovation.

Deregulated expression of the BCL-2 protein family of proteins is a hallmark of many cancers and frequently underlies cancer drug resistance. Accordingly, a number of major pharmaceutical companies have now developed drugs (called BH3 mimetics) that can target most of the pro-survival proteins in the pathway, including BCL-2, BCL-XL, BCL-W and MCL-1 (**Fig. 1A**). To first gain some insight into the role of these proteins in MPM, we examined their expression in a panel of cell lines at mRNA and protein levels. These data showed that BCL-XL and MCl-1 were the dominant pro-survival proteins expressed, though most of the pro-apoptotic proteins were also present including BAX, BAK and several BH3-only proteins, including BIM. Hence, these cells possessed an 'intact' intrinsic apoptotic pathway, suggesting BH3-mimetic drugs could be effective at killing them.

To establish the efficacy of BH3-mimetics in MPM, we next tested a panel of these drugs that either targeted subsets of pro-survival proteins or certain family members very specifically. When used on their own, only drugs able to target BCL-XL were effective (e.g. ABT-263, A-1331852). However, these responses were dramatically enhanced when the drugs were combined with an MCL-1 inhibitor (**Fig. 1B**), consistent with the high-level expression of BCL-XL and MCL-1 in the cell lines. Combinations of the BCL-XL inhibitors with standard-of-care chemotherapy also resulted in enhanced MPM cell killing compared to the effects of either drug alone.

Whilst these data were promising, it was important to determine whether similar efficacy could be achieved *in vivo*. Indeed, xenograft studies showed that ABT-263 and A-1331852 could extend mouse survival (time to ethical endpoint based on tumour size), and this survival time was further enhanced (essentially doubling survival) when the drugs were combined with cisplatin (**Fig. 1C**). Unfortunately, combinations of BCL-XL and MCL-1 inhibitors led to fatal toxicity in mice so we could not directly test that combination of drugs in our studies. However, by using an indirect approach whereby we deleted MCL-1 using CRISPR/Cas9 in the

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Some of the team involved in this study at the ONJCRI, from left: Megan O'Brien, Tiffany Harris, Laura Jenkins, John Mariadason, Doug Fairlie, Erinna Lee, David Williams, Nikita Steinohrt and Ashleigh Poh.

Surein Arulananda.

Tom John.

tumours, we show that the effect of BCL-XL inhibitors could also be enhanced if MCL-1 was neutralised, as observed *in vitro*.

Finally, we wanted to establish whether the BCL-2 protein expression patterns we observed in our cell lines was similarly reflected in patient samples. Using a large tissue microarray of over 300 tumour samples, we showed that BCL-XL was the pro-survival protein that was almost uniformly expressed at high levels in the vast majority of patients, followed by MCL-1 (**Fig. 1D**). High-level BCL-2 expression was only observed in a small proportion of patients. Hence, these data suggest that our observations on the efficacy of BH3-mimetics in cells lines should also be relevant to patients.

Overall, these studies provide a compelling rationale for the clinical investigation of BH3-mimetics BCL-XL in MPM.

Doug Fairlie and Erinna Lee
Olivia Newton-John Cancer Research Institute and La Trobe University

Changes in Open–closed Sampling During the Evolution of Cyclohexadienyl Dehydratase Enzyme

Kaczmarski JA, Mahawaththa MC, Feintuch A, Clifton BE, Adams LA, Goldfarb D*, Otting G*, Jackson CJ*. Altered conformational sampling along an evolutionary trajectory changes the catalytic activity of an enzyme. *Nat Commun* 2020;11(1):5945.
***Corresponding authors: colin.jackson@anu.edu.au, gottfried.otting@anu.edu.au, daniella.goldfarb@weizmann.ac.il**

In our recent work, published in *Nature Communications*, we used structural analysis, double electron–electron resonance (DEER) measurements and molecular dynamics (MD) simulations to trace how rigid-body conformational sampling was optimised during the evolution of a new enzyme activity.

The enzyme cyclohexadienyl dehydratase (CDT) is a member of the periplasmic solute-binding protein (PBP) family and is closely related to polar amino acid-binding proteins. The PBP fold is intrinsically dynamic; in solution, hinge-bending and hinge-twisting motions move the two domains of PBPs together (closed state) and apart (open state, **Fig. 1a**). In canonical PBPs, ligands bind between the two domains and stabilise the closed state by forming bridging interactions between the two domains (**Fig. 1b**). This ligand-induced switch is important for the canonical role of PBPs in solute-transport and signalling pathways, and the extent of the intrinsic open–closed conformational sampling is under selective pressure since it influences ligand-binding affinity and selectivity. While the majority of the PBPs are non-catalytic, CDT is an efficient dehydratase ($k_{cat}/K_M \sim 10^6$ $M^{-1}s^{-1}$). Considering that the open state of CDT would be catalytically unproductive (due to lack of active site pre-organisation), we wondered whether the relative sampling of open and closed states had changed during the natural evolution and optimisation of this enzyme.

In previous work, we used ancestral sequence reconstruction to reconstruct ancestors of CDT, showing that present-day CDTs evolved from a cationic amino acid binding protein, AncCDT-1 (**Fig. 1c**). Dehydratase activity emerged in intermediate ancestors (AncCDT-3

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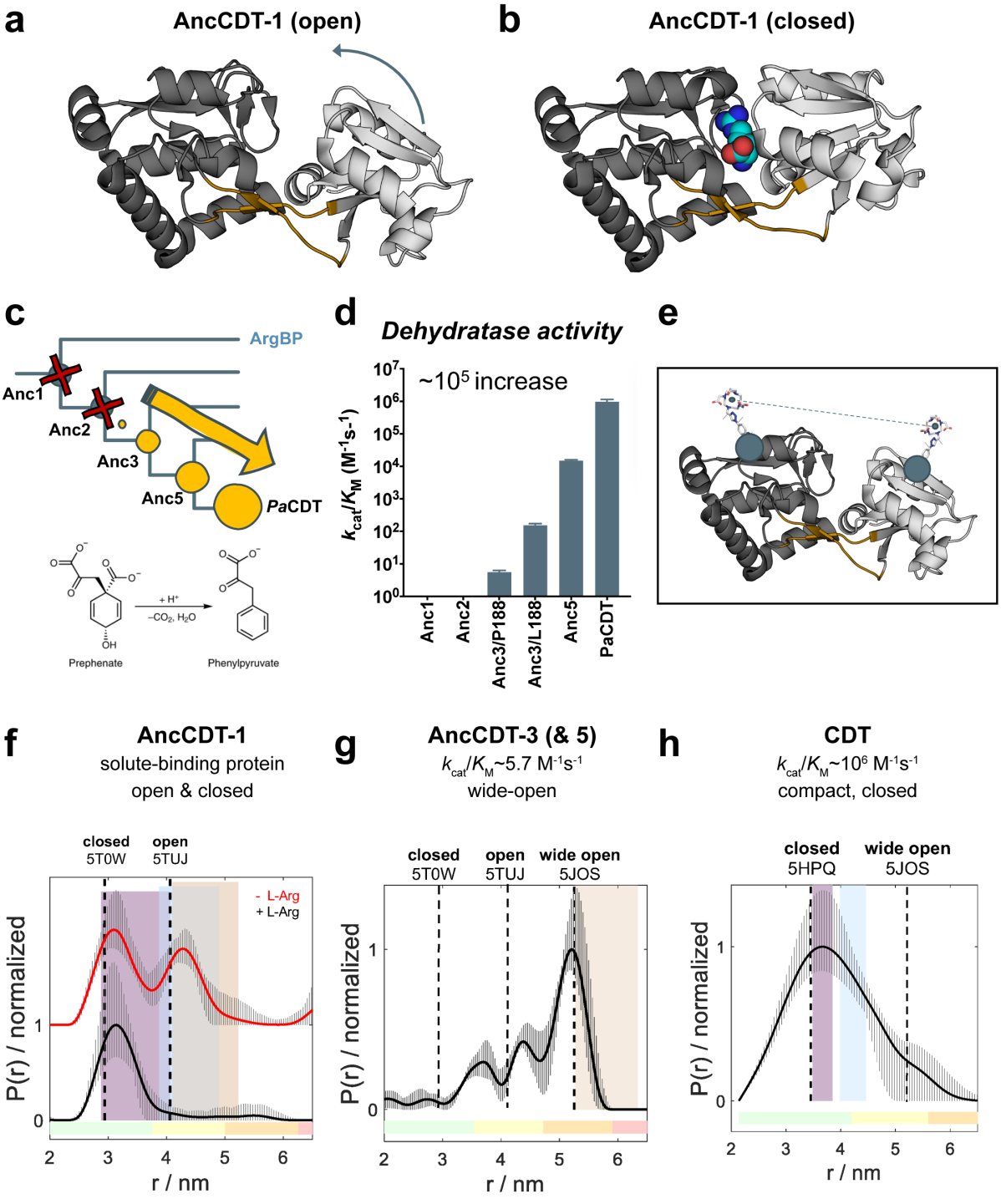

The evolution of a cyclohexadienyl dehydratase (CDT).

a–b. *Proteins with the periplasmic protein fold sample both open **(a)** and closed **(b)** states in solution.*

c. *In previous work, we characterised ancestors of CDT, including AncCDT-1, AncCDT-3 and AncCDT-5.*

d. *Dehydratase activity increases ~10^5-fold between AncCDT-3 and modern CDT.*

e. *We performed double electron–electron resonance spectroscopy by incorporating Gd(III) containing tags on the two domains of the proteins.*

f–h. *Distance distributions from DEER, showing a shift in open-closed sampling along the evolutionary trajectory from AncCDT-1 to CDT.*

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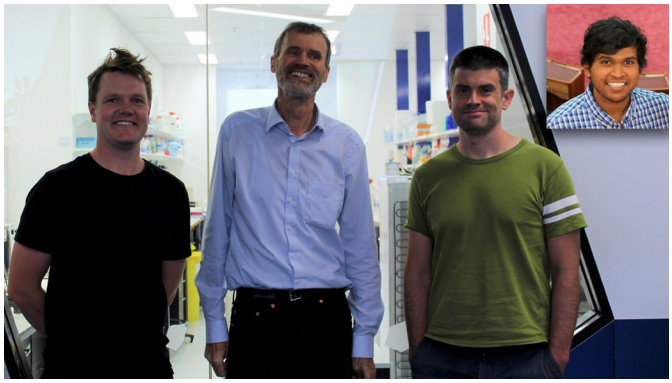
to AncCDT-5), with dehydratase activity increasing almost 106-fold between AncCDT-3 and the modern enzyme (**Fig. 1d**). However, we could not rationalise this increase in catalysis based on sequence and structural analysis alone; all of the active site residues present in modern CDT were also present in the inactive AncCDT-2, and the primitive enzymes, AncCDT-3 and AncCDT-5.

In our recent study, we worked closely with the groups of Gottfried Otting (Australian National University) and Daniella Goldfarb (Weizmann Institute of Science, Israel) to investigate whether changes in conformational sampling may be contributing to the increase in catalytic activity. We obtained an additional crystal structure (of AncCDT-5), which highlighted how a second-shell substitution occurring between AncCDT-3 and AncCDT-5 stabilised a key active site residue, coinciding with an approximately 400-fold increase in k_{cat}.

Next, by using unnatural amino acid incorporation, we were able to site-specifically incorporate Gd(III)-containing tags into each of the two domains of AncCDT-1, AncCDT-3, AncCDT-5 and CDT (**Fig. 1e**), allowing us to assess the distribution of open and closed states in these proteins using DEER spectroscopy. DEER data perfectly matched what we observed in MD simulations. Specifically, AncCDT-1 sampled both open and closed states in the absence of a ligand (**Fig. 1f**), as is typical for a solute-binding protein. However, the intermediate ancestors AncCDT-3 and AncCDT-5 almost exclusively sampled a wide-open conformation (**Fig. 1g**), which we reasoned would be catalytically unproductive. Indeed, DEER and MD for the modern CDT enzyme was consistent with sampling of much more compact, closed (and catalytically-relevant) states (**Fig. 1h**), and coincided with an approximately 15-fold decrease in K_M. Further analysis revealed that this shift in conformational sampling arose, in part, through the oligomerisation of the protein, as well as the addition of terminal residues that helped to link the two domains of the modern CDT.

Together, the results from this study highlight how conformational sampling was altered during the natural evolution of a new enzyme activity to lead to improved catalytic efficiency.



The ANU-based authors of this study, from left: Joe Kaczmarski, Gottfried Otting, Colin Jackson and Mithun Mahawaththa (inset).

Joe Kaczmarski (@kaczmarski_joe)
and Colin Jackson (@jackson_lab)
Research School of Chemistry
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ASBMB Education Feature

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A Picture Paints a Thousand Words: Infographics for Authentic Learning in Undergraduate Students

Saw Hoon Lim and Rosa McCarty, Department of Biochemistry and Pharmacology, University of Melbourne

Frontiers in Biomedicine is a final semester capstone subject for third year Bachelor of Biomedicine students at the University of Melbourne. In this subject, we take a holistic approach to understanding established and developing issues affecting both health and disease, by exploring the breadth of complex determinants across disciplinary boundaries. An important learning outcome is for our students to synthesise and integrate information on selected health matters in a coherent narrative, from differing perspectives.

One of the four major health issues that we examine is the metabolic syndrome, which has an associated assignment themed 'Writing for Your Audience' involving three interrelated tasks. Students are provided with the following real-world context. They are employed to develop educational material for the Victorian Government's Better Health Channel for two audiences: health practitioners and a lay audience. In the third task, students reflect upon and articulate the strategies they used to tailor their presentations to the two audiences.

The lay writing task was an update to the previous year's assignment, which was a plain text submission. Students were asked to prepare an infographic for the general public around metabolic syndrome. This follows earlier studies that have shown that the infographic development process increases engagement, promotes deeper learning and improves student skills through the distillation of information for a non-expert audience (1,2). To fully immerse the students in this assignment, instructions to this activity were also presented as an infographic (**Fig. 1**). As we anticipated, students relished the opportunity to bring to life their learning in an eye-catching format, capitalising on visual storytelling to deliver their health message. They did not disappoint! The infographics produced were of stellar quality and carefully considered, with creative use of pictorial representations to effectively communicate and stimulate the interest of their audience. They realised through this assignment that often, less is more when conveying complex concepts and information to engage with your audience (3). From our student evaluation survey (n=124), 73% indicated that this was a good/excellent assignment (four and five of a maximum Likert Scale of five). Many students commented that they enjoyed and benefitted from this assignment. This is an excellent outcome as biomedicine cohorts are very high achievers.

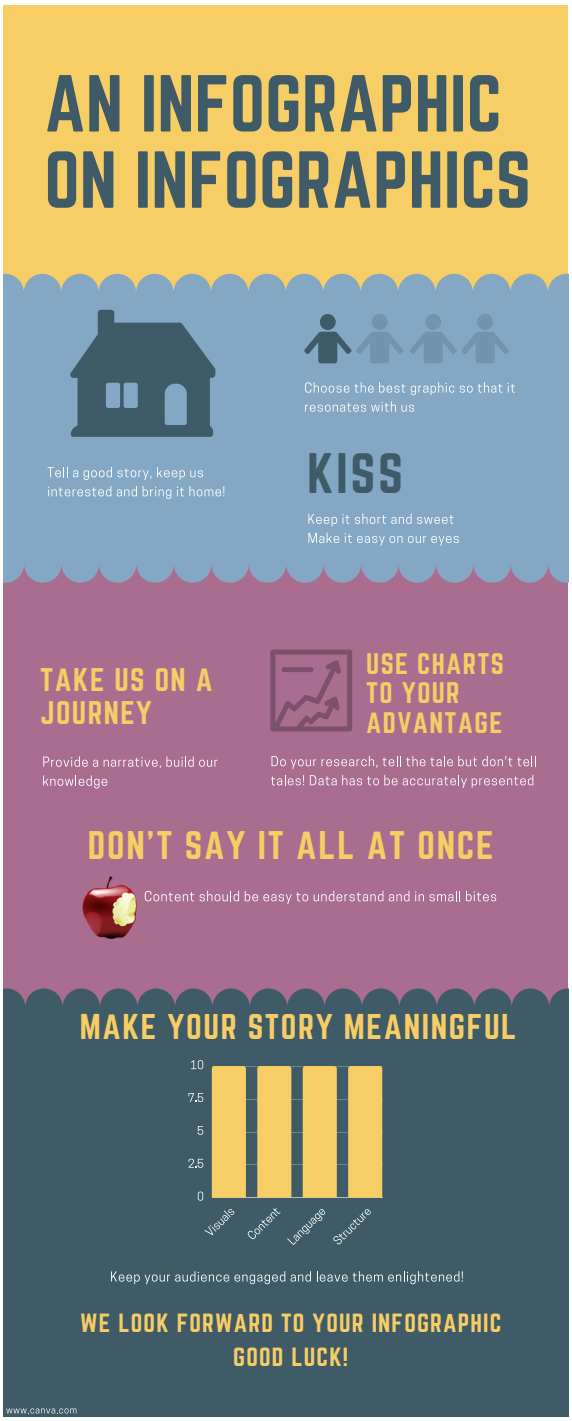
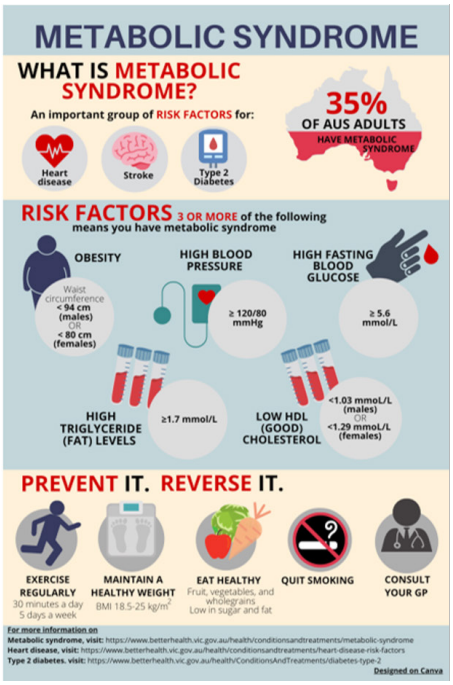
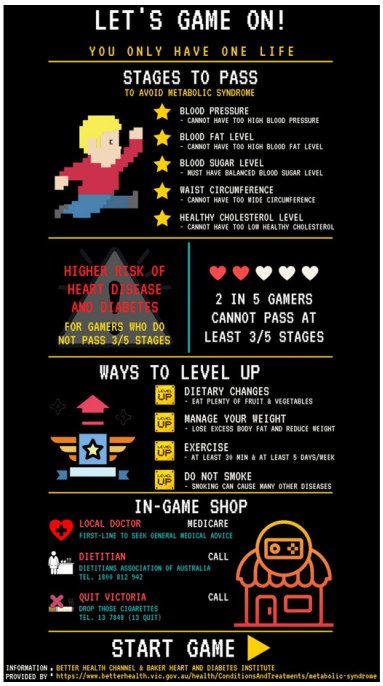


Fig. 1. *Instructions on creating an infographic were delivered via an infographic.*





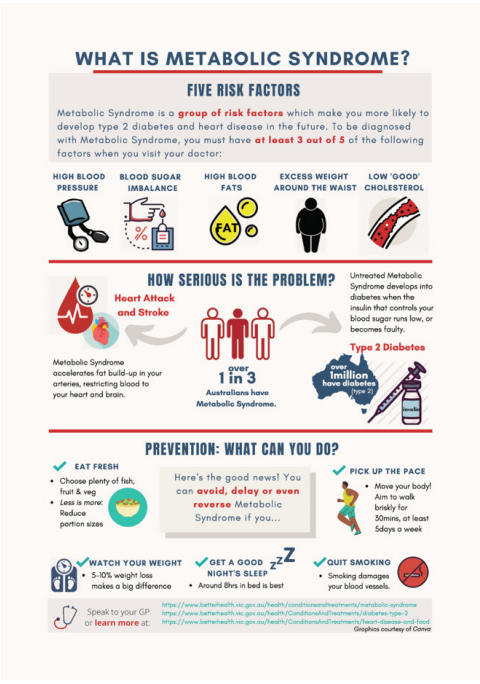


Fig. 2. *The top three infographics as voted by students in Frontiers in Biomedicine, University of Melbourne, 2020.*

We were overwhelmed by the standard of the infographics produced in terms of clarity of presentation and creativity in disseminating knowledge about the metabolic syndrome. To reinforce the authentic nature of the task, we decided to share their creations with the Australian Medical Association, the Heart Foundation and Diabetes Australia in the hope that they will find these infographics useful as information for the public, bringing to life the assignment's scenario. We employed a democratic and entertaining approach to select which infographics were shared by inviting the cohort to vote for their favorite infographics (which were shortlisted by their tutors), dubbing this 'the people's choice award'. This had the tripartite benefit of garnering the students' voice, allowing students to learn from their peers and building camaraderie. A total of 118 votes were received and the top three infographics made their way to those organisations (**Fig. 2**).

We are delighted to report that Diabetes Victoria has responded to us very positively. They stated that the depiction of health information pictorially is an important way to improve health literacy and that they will consider how they might use our students' infographics in the future. This news was indeed a fitting conclusion to our infographic assignment. Moreover, our students have used creativity to consolidate their learning and communicate their understanding.

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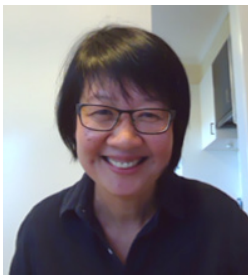

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The Journey from Teaching Face-to-face, to Online, and Back Again – Revealing Four Important Elements of Effective Teaching and Learning

Nikki Curthoys, School of Chemistry and Molecular Bioscience, University of Wollongong

I am a teaching-intensive lecturer with experience as a laboratory demonstrator, tutor, lecturer and subject coordinator. After delivering entirely remotely in 2020, I am relishing a return to face-to-face teaching. We have watched our students lose their access to physical practical skills, which are fundamental to what we do as biochemists and molecular biologists. These learners also missed out on the face-to-face engagement in lectures and tutorials. However, this year has revitalised some core tenets of effective teaching, which we can now apply into the future. There are many elements that lead to effective student learning; below I focus on just four that resonated with me through my experiences in moving teaching from face-to-face to online and back again.

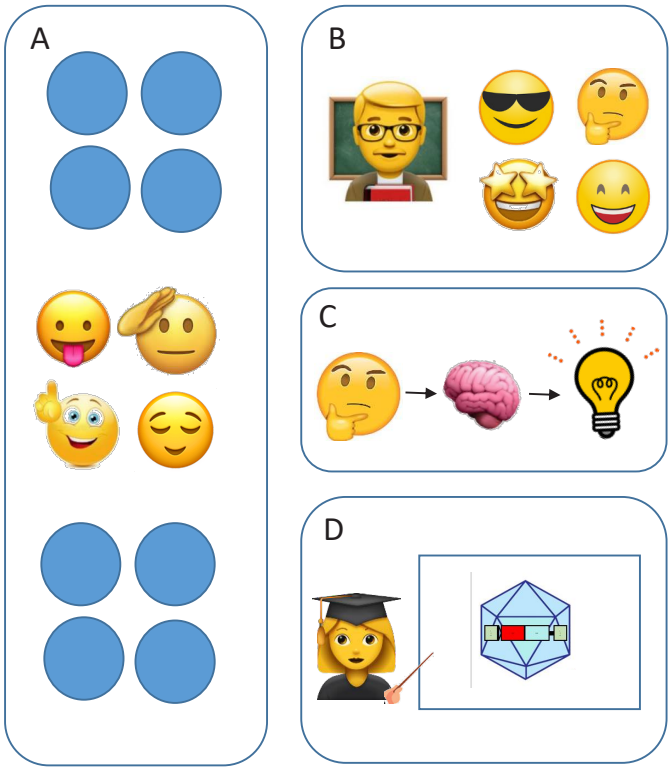

Fig. 1. *Four essential elements for effective teaching and learning:*
A. *Small group teaching.*
B. *Casual staff to support students.*
C. *Active learning strategies.*
D. *Quality teaching materials.*

1. Small group learning

Small group teaching is essential for effective learning. Online teaching has (at times) resulted in large classes of silent, disembodied logos who will not turn on their camera or their microphone; only indicating their presence with perhaps a word or two in the chat bar. Teaching students in large groups (even 30 students) can really stifle engagement. Our learners openly appreciate working in smaller groups of two to four, rather than a group of 30. Breakout rooms are effective online; just as small group work is effective face-to-face.

2. Learners need support – casuals are essential

Effective teaching requires support for teaching assistants. They are an essential element of the teaching team and are inextricably linked to effective student learning. Smaller group teaching certainly helps, but we all know of situations where learners are hesitant to participate – because they are nervous, disinterested, or otherwise disengaged. We want all learners to demonstrate their understanding of the material – and to feel comfortable in exploring what they don't understand. In my experience, crucial to this is having academics and casual teaching staff who actively engage with the learners in these small groups.

3. Long lectures can be boring

Utilising active learning strategies in all facets of teaching supports student learning. We've all been there, listening passively to long lectures whilst trying to process a wealth of information. Last year, an education designer reminded me I have an attention span of about eight minutes (and that's on a good day!). In 2020, I broke up and focused my sometimes two-hour long lectures into smaller, manageable chunks of about 20 minutes of information to keep learners stimulated. I also reconnected with active learning strategies. These practices transform learners from passive observers to living, participating members of the subject.

4. Quality teaching materials require ongoing development

Simple but informative instructional material using a variety of media can enhance student learning. Nothing spells nap-time like a bank of PowerPoint slides which are bulletpoint wads of text that a lecturer duly reads off verbatim, with the implicit connotation that the learners

are illiterate. Throughout 2020, we rapidly evolved our learning materials – not just with slick animations and fun demonstrations. A few well-explained, informative images really aids understanding. Redesigning or updating teaching material yields big increases in learner comprehension – especially when subject matter is inherently visual; like so much of molecular biology and biochemistry.

As we return to face-to-face delivery, we will all take our learnings from remote teaching back into the classroom and laboratory. This will undoubtedly enhance the experience not only for ourselves, but also our colleagues and students. Whilst I have captured just four elements that stood out to me, I wonder what stood out to you?

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Silver Linings of Rapidly Transformed Biochemistry Laboratory Teaching During the COVID-19 Pandemic

Joanne Castelli, Sean Ramsey, Alyssa Van Dreumel and Peter Arthur
School of Molecular Sciences, University of Western Australia

Laboratory training for University of Western Australia Biochemistry undergraduates follows a well-established *Prepare Do Review* model (1), a flipped learning modular format based on specific laboratory techniques. Students *Prepare* by undertaking online pre-labs consisting of watching videos and PowerPoint presentations, and completing readings and formative and summative quizzes, all available on the learning management system (LMS). This preparation means when they *Do* the practical experiment in the laboratory they can concentrate on the hands-on techniques, troubleshooting and problem-solving aspects of the lab. The following week, students *Review* their learning by preparing for oral presentations and completing an in-class quiz in the post-laboratory session.

The model has been very successful, but we decided there is always room for improvement, so we formed a Community of Practice to bring together expertise from across the university to help us transform the way we teach in the laboratory.

The emergence of the COVID-19 pandemic disrupted our plans to review the course in 2020. We had started teaching the unit BIOC2001 Biochemistry and Molecular Biology of the Cell to a cohort of 102 second year students. The students were already familiar with preparing for their laboratory sessions with asynchronous online teaching, but suddenly we had to convert the laboratory and post-laboratory sessions to emergency remote teaching formats.

The laboratory procedures were filmed using a GoPro, and edited to produce five-minute videos. Laboratory sessions incorporating active learning strategies were presented and recorded synchronously using Zoom with up to 50 students in each session. In these sessions, students watched the video and discussed the theoretical background and techniques with learning supported using formative Zoom Poll questions. The video was then repeated, with the demonstrator stopping and starting the video in order to clarify concepts and respond to questions posted by students in the Zoom Chat. Preset questions related to the laboratory were completed and discussed online as a group, using audio and video or the Chat feature of Zoom.

Fig. 1. *Demonstrator Sean Ramsey presents the laboratory to students via an interactive Zoom session.*

In the following week, during synchronous Zoom sessions, students delivered one five-minute PowerPoint presentation each over the course of the semester. These sessions were recorded and will be useful for future assessment moderation, and as a training tool for new markers. The students finished the module with a summative asynchronous LMS quiz.

There were many challenges in the synchronous online delivery that were not under our control. The differences in student access to technology and internet needed to be considered to ensure we took steps to make the learning as equitable as possible by providing learning alternatives and recordings.

We are strong advocates for the value of hands-on laboratory experience and it has become even clearer the teamwork, problem solving, manipulations and precision work that students learn from being in the laboratory can't be taught effectively online. But there are silver linings, as we have developed new skills and resources that support both student and teacher in learning during hands-on laboratories. Students have increased their digital skills by adapting to new ways of learning and sharing their knowledge. Teachers have had to prepare new learning materials and ways to ask questions, and plan for delivery in unconventional ways. We have gained expertise in new ways of online synchronous and asynchronous teaching and now have a trove of resources, including videos, poll and quiz questions, student and demonstrator feedback and student presentations. The reflections we have made and the changes we will implement in the future will ultimately improve the learning experience for us and our students.

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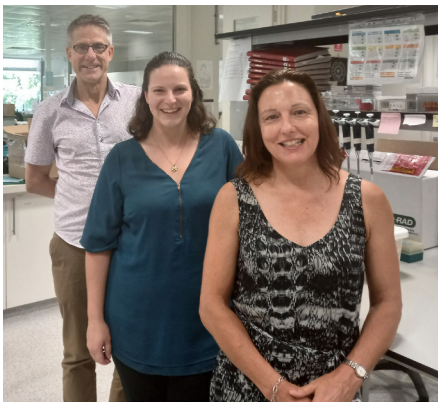

From left: Peter Arthur, Alyssa Van Dreumel and Joanne Castelli.

Skill Development in the Online Laboratory Class

Jessica Gibbons, Biomedical Discovery Institute, Monash University

For many of us, one of the biggest challenges for teaching in 2020 was rapidly converting our laboratory classes to online equivalents. Our students would not have the opportunity to develop technical laboratory skills, so we decided to focus on the skills we knew we could develop without the laboratory classroom: scientific communication, experimental design, and data analysis and interpretation.

Our approach

To replace ten weeks of wet laboratory classes for our first year molecular biology unit within the Bachelor of Biomedical Science course, we designed a suite of ten online laboratories and divided the program into two phases. The first five-week phase was dedicated to teaching students about individual laboratory techniques such as PCR, assays and cloning. Students were also introduced to data interpretation and analysis, exploring imperfect results, failed experiments and troubleshooting.

In the second phase, the focus of the laboratories shifted to a project-style sequence investigating the plasmid pGlo and the controlled expression of green fluorescent proteins (GFP), adapted from (1). Students used the techniques learnt in phase 1 to design a course of experimental enquiry to investigate the effect of mutations and the effect they have on GFP, including mutations that change its fluorescence from green to blue. Students were required to make hypotheses, analyse experimental data and draw conclusions.

Weekly format

Each week students had four parts to their online laboratory that replaced the weekly three-hour face to face session (**Fig. 1**). Part 1 comprised an interactive online module that introduced them to the week's experiment (**Fig. 2**). Students also completed a short multiple choice quiz (Part 2) prior to their Zoom session to encourage them to work through the online module.

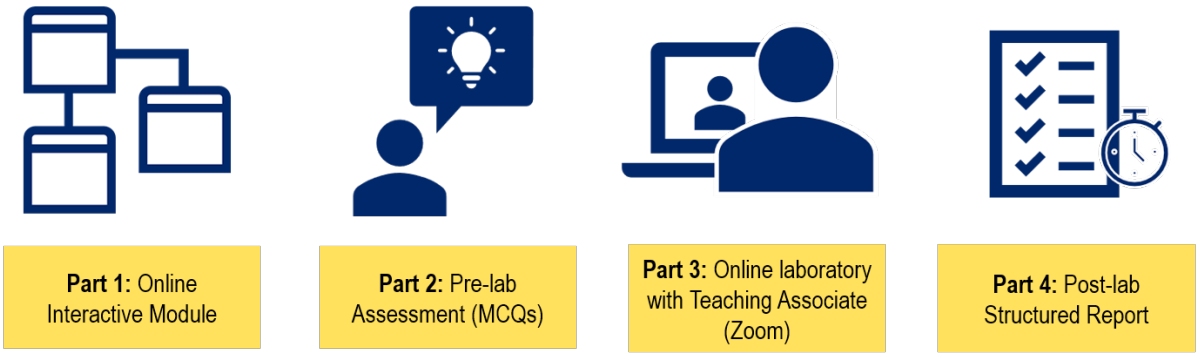

Fig. 1. *The components of the weekly online laboratory sessions.*

Impact and conclusions

Feedback from the end of semester unit evaluation was overwhelmingly positive towards the online laboratory program. Students found the interactive online modules effective in preparing them for the online sessions, which they found valuable in consolidating their understanding overall. Students also reported that the assessment was effective in developing scientific communication skills:

> "The labs were very engaging and I found that I gained a greater understanding of the particular topic investigated each week than I would have by passively learning about it"
>
> "The laboratories were extremely helpful in demonstrating the practical application of the molecular biology content, as well as developing key skills required in scientific investigation such as constructing a scientific report"
>
> "I liked the continuation of the 'same' topic (pGLO plasmid) for the later weeks in lab sessions – this was fun and engaging to learn in depth about the processes required for various types of experiments"

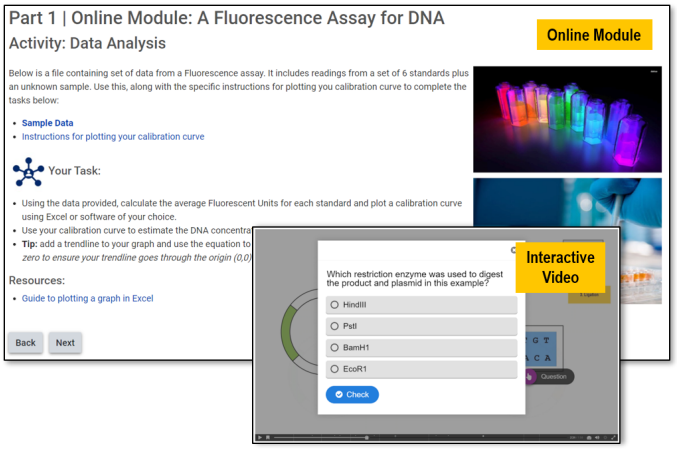

Fig. 2. *The weekly online modules included a range of activities for students to complete prior to attending the online Zoom session with their teaching associates including interactive videos, questions to consider and tasks such as data analysis shown here.*

While students weren't able to perform the experiments themselves, they gained exposure to the execution of a scientific project, and experimental techniques that are not always possible in an undergraduate laboratory.

Reference

1. Girón MD, Salto R (2011) *Biochem Mol Biol Educ* 39:309–315.

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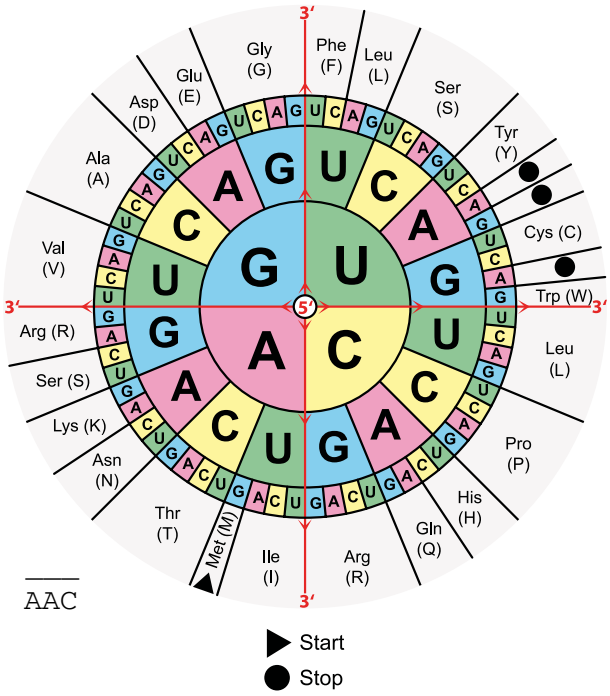
Competition: Codon Wheel

Presenting the latest competition for the members of ASBMB.
All correct entries received by the Editor (editor@asbmb.org.au) by 1 June 2021 will enter the draw to receive a voucher. With thanks to Joe Kaczmarski.

Use the codon wheel below to translate these DNA sequences. Some of the sequencing results are missing, so you will need to figure out what these missing amino acids should be. The missing amino acids in one letter code spell the answer.

1	___ GTG	___ ATT	___ ???	___ GAA	___ AAC	___ ACC	___ ATT	___ AAC	
2	___ AAA	___ GAA	___ CGC	___ ???	___ ACC	___ ATT	___ AAC		
3	___ ???	___ GAA	___ CGG	___ CCG	___ ATT	___ AAC			
4	___ ACC	___ ATT	___ ???	___ ATT	___ AAC				
5	___ TTT	___ ???	___ CGC	___ CGC	___ ATT	___ ACC	___ ATT	___ AAC	
6	___ ATG	___ GAA	___ ???	___ CTG	___ ATT	___ AAC			
7	___ TGC	___ GCG	___ ???	___ CAT	___ GAA	___ CGC	___ ATT	___ AAC	
8	___ ???	___ CTG	___ GCG	___ AGC	___ ACC	___ ATT	___ AAC		
9	___ GCG	___ ???	___ ACC	___ ATT	___ AAC				
10	___ TTT	___ ???	___ CTG	___ GCG	___ GGC	___ GGC	___ CGC	___ ATT	___ AAC
11	___ ???	___ CTG	___ GCG	___ AAA	___ ATT	___ AAC			
12	___ ???	___ GAA	___ CTG	___ ATT	___ TGC	___ GCG	___ AGC	___ GAA	
13	___ TGC	___ GCG	___ ACC	___ ???	___ AAC	___ ATT	___ AAC		
14	___ TGC	___ ???	___ TAT	___ AGC	___ ACC	___ GCG	___ CTG	___ CTG	___ ATT	___ AAC
15	___ AGC	___ CCG	___ ???	___ TGC	___ ACC	___ CGC	___ ATT	___ AAC	
16	___ ATT	___ AAC	___ ACC	___ GAA	___ GGC	___ ???	___ ATT	___ AAC	



ANSWER: I AM A _____ _____!

SDS Page: Short Discussions for Students Page

The Art of Teaching Yourself How to Write

Crisdion Krstevski, Baker Heart and Diabetes Institute and Department of Physiology, Anatomy and Microbiology, La Trobe University

One of the most challenging aspects of being a scientist is communicating your findings to the immediate scientific community and the rest of the world. In our early years as researchers, we all aim to break through new boundaries and expand upon the foundations of tremendous researchers before us. Our pursuit to understanding perplexing theories or hypothesises in our given fields is momentous in itself. Simultaneously to making leaps and bounds, we face the task of having to learn how to write to our audience. Yes, of course we all know how to write a sentence, a paragraph, perhaps even a short story. Yet, how we convey our findings can often be detrimental to the outcome of a manuscript or publication being accepted or rejected. Together with the help of those in the team I work with in the first year of my PhD, I have navigated a range or methods to teach myself to write. Here, I've shared some little tips and tricks in learning the 'art of teaching myself how to write'.

Brainstorming and word vomit

Often an underappreciated tool that we all have used at some stage in our lives is brainstorming. A crucial step in the writing process is getting out your initial thoughts. In our lab, our windows are populated with thoughts on manuscripts, ideas for future projects, and summaries of discussions. You may wonder, how is writing my ideas on a window going to help? Well, this is important as it allows your mind to start forming links between the small ideas that ultimately lead to the overarching question you're trying to answer. This form of consolidation from this simple task is a fundamental feature in the writing process, as you can already begin to refine the information you will include in your final piece of writing.

A set of words thrown around in our lab almost weekly are 'word vomit'. In the words themselves they are telling you what to do! Use them to your advantage. For those that like sport, you will be familiar with the famous Nike slogan 'Just Do It'. Much like a high-performance athlete, scientists can benefit from this method. In most instances we get stuck in refining our ideas from the beginning of writing process. However, by 'word vomiting' our ideas, we embark on another important step in our progress to our final product. Although an unorthodox approach, it allows us to make important links and ultimately make refinements to our ideas. These marginal gains are crucial in the art of writing, often making the difference in the final product.

Expanding vocabulary

A crucial aspect of developing our writing skills is having a good understanding of the literature in our relevant field. When we are reading literature in our field, we can learn both from the findings made and the style of writing and vocabulary utilised. It is not a traditional tool but can be useful for developing a piece of writing especially going towards publication material. Along with studying the language utilised in literature, there are some other small tricks to work on your vocabulary.

Being only at the beginning of my own research career, I am still trying to create a more expansive vocabulary. In order to do this, members of my lab have introduced a 'word of the week'. The fundamental idea revolves around incorporating some key words that we can use in our own writing in our everyday conversations. It's a simple activity that allows you to develop a proper understanding of how to use key words in both conversation (which is helpful for future talks and presentations) and also a fundamental tool for us developing our writing skills.

Workshops and other opportunities to write

When beginning my journey on teaching myself to write, I found value in going to workshops on writing structure. These workshops, which most universities offer, allow you to think about key ideas and principles behind writing. The other advantage of using this type of resource is

Fig. 1. *Tips and hints on teaching yourself to write.*

SDS Page: Short Discussions for Students Page

that these are mostly run by more senior academics or staff that have extensive writing experience. This type of resource certainly helped me develop my writing. In addition to workshops, you should make sure you take every opportunity you can to write.

Welcoming criticism

Perhaps the most powerful tool of all is embracing the criticism. Out of all the little learnings, accepting criticism is by far one of the toughest. However, this will potentially be what develops your writing the most. It is something that you can get from anyone around you. Try explaining the last manuscript you've written or drafted to a friend or family member. They themselves may not give you feedback, however you will notice small details you may have missed in the past. Don't forget you also have colleagues around you! They can offer you those intricate details in your writing you may have missed. You will find these criticisms will assist in taking your writing to the next level.

Summary

Writing is an art. For everyone learning to write is different. These small tips, hints and tricks that I have used along the way are helping me to become a better communicator and improve my writing. I'm still learning and finding more ways to develop. I hope my experiences that I have shared here help others in their journeys as early career researchers.

Crisdion Krstevski is a PhD candidate at the Baker Heart and Diabetes Institute and La Trobe University.
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Off the Beaten Track

Written by former researchers who have now established careers outside of research, Off the Beaten Track is intended to give the readers insights into the range of alternative careers available to them. Authors describe the paths they have taken to arrive at their present career and provide a detailed description of exactly what the job entails on a day-to-day basis.

Now I Work with Mice That Have Batteries in Them

Krish Jayatilleke, Clinical Research Associate, GenesisCare Clinical Contract Research Organisation

Krish Jayatilleke.

Next to moving to Australia alone as an international student in early 2008, committing to do a PhD was the biggest decision that I'd made. Over the years, my career pathway has been anything but orthodox and it's only now, in hindsight, that I can see how everything fell into place.

Soon after arriving in Melbourne and starting my Master's degree in Biotechnology and Bioinformatics at La Trobe University, I spoke to my course coordinator on gaining some voluntary hands-on research experience. I was soon offered a position in Professor Nick Hoogenraad's laboratory, which was a part of the Co-operative Research Centre (CRC) for Biomarker Translation. This eventually turned into my first paid job as a part-time research assistant, which for me as an international student, couldn't be better! This was also a great catalyst for my career. I worked within the CRC whilst completing my Master's research project investigating mitochondrial stress-response proteins, supervised by Professor Hoogenraad. I decided against a PhD and opted to remain employed as a research assistant whilst I applied for my Australian permanent residency, which in retrospect was the right call. Halfway through the next three years with the CRC, I was asked to assist in a project on the early pre-clinical validation of a novel anti-Fn-14 antibody, which yielded very promising results in cancer cachexia. This work ignited a strong interest in cancer research that helped lead me to where I am today. Following my time at the CRC, I joined Dr Belinda Parker's breast cancer research group as a research assistant. Two years in, I experienced what I would describe as a 'quarter-life crisis'; even though I enjoyed my work, I knew that I wanted more. Studying further had always been the plan, and a PhD was beginning to seem increasingly attractive.

Several months were spent on deciding my next move, which led me to realise that as much as I appreciated laboratory-based research, my true interest lay in healthcare and in the 'sweet spot' of cancer research, where novel therapeutics were brought to life through clinical trials. My plan was to complete a PhD in cancer and to attend medical school, specialise in oncology and become a clinician–scientist, leading my own clinical trials. Deciding early on against an academic career was key in helping me focus on what I wanted and most importantly, move away from what I did not.

I completed my PhD with Professor Mark Hulett at La Trobe University, investigating the role of heparanase in breast cancer, whilst planning to attend medical school. As there were no guarantees that I would even be accepted to medical school, let alone be successful in specialising as an oncologist, I decided to explore potential alternative avenues. I attended as many industry seminars, conferences and workshops as I could throughout my PhD and built up connections within industry. At the AusBiotech National Conference in late 2017, during the last few months of my PhD, I had a five-minute conversation that changed my life. At the time, I was very keen on career opportunities in clinical trials and I introduced myself to an invited speaker from GenesisCare, after attending her talk on conducting clinical trials. Looking to get my foot in the door, I asked if I could 'tag-along' as a volunteer to learn about the organisation and about clinical trials. After a three-month part-time stint as an intern, I was offered the position of National Lead Theranostics Clinical Research Coordinator, which I commenced in July 2018. It really is not about who you know, but rather about who knows you.

I am currently in my third role within GenesisCare, having previously been a Clinical Research Associate (CRA) on our national skin cancer and benign conditions research program. GenesisCare is one of the largest providers of cancer treatment in the world and is the largest provider

Off the Beaten Track

of cancer and cardiology treatment in Australia. This enables us to not only treat thousands of patients a day globally, but also to conduct a wide range of clinical trials. The Contract Research Organisation is a new addition to GenesisCare and we are a small but growing team of about fifteen. As a CRA, I provide oversight to clinical trials which involve building relationships with GenesisCare sites throughout Australia and ensuring that clinical studies are set up and are being conducted successfully. I liaise with project managers, clinicians and research coordinators across the country and also liaise with external organisations such as pharmaceutical companies, who approach GenesisCare with novel treatments that must be validated through clinical trials prior to regulatory approval. Even though I hung up my lab coat years ago and have undoubtedly lost my technical skills, the 'soft' skills such as communication and project management skills gained from my PhD have proven invaluable. My CRA role originally required a significant volume of travel but in the current climate of COVID-19-related remote work, my work is primarily accomplished on my laptop. Since joining GenesisCare, I have worked mainly from home, which after being based in a university laboratory, was challenging at first. So was the first day in the office in smart attire, after spending more than a decade at the university where every single day was casual Friday! Work can be demanding, especially as I am involved in several very distinct clinical trials. This means strict deadlines and a range of deliverables, not to mention many Zoom meetings, phone calls and emails throughout the day. Even though what I do now is very different to what I had planned when I started my PhD, I do play a small role in helping to improve the way we treat, manage and diagnose disease, which is very fulfilling.

The Australian clinical trials landscape is set to expand over the coming years, which will provide many opportunities for those interested in a career change. Even though there is no magic formula to leaving academia and joining the industry, the key lessons that I learnt during my journey hold true: have a plan, start early, network to explore your options and ask for what you want. My time at university and as a PhD student now seem like a distant memory, but there is no doubt in my mind that they absolutely prepared me for where I am today.

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From Researcher to IP Professional: Interview with a Patent Attorney

Sarah Hennebry interviews Sheila Barbero, an Associate at FPA Patent Attorneys, providing insights into the patent attorney profession and Sheila's journey from researcher to IP professional.

Above: Sarah Hennebry
Right: Sheila Barbero

Hi Sheila! Thanks for taking the time to give our readers an insight into life as a patent attorney and your journey from the lab bench to patent attorney.

To get us started, could you tell our readers briefly what a patent attorney is?

A patent attorney is a specialised legal professional qualified to represent inventors/patent applicants before a particular Patent Office.

In Australia, a patent attorney is not a lawyer; we're more like scientists with specialist training and qualifications in intellectual property (IP) law.

Can you tell our readers what patent attorneys do; if you're not lawyers, how is the work different?

Patent attorneys work with clients to protect their inventions; these can be things like new products (eg a new drug or a device), manufacturing processes, and methods of treating or diagnosing diseases.

We work with a wide variety of clients; from 'backyard' inventors, researchers at Australian universities and research institutes, small and medium size biotechs, to large multinational companies.

Importantly, only Australian patent attorneys can file patent applications on behalf of their clients at the Australian patent office.

Unlike lawyers, patent attorneys are required to have a technical qualification. That is why most patent attorneys (at least in the life sciences/chemistry space) have PhDs, and often postdoctoral research experience.

The day-to-day work of a patent attorney includes:

- Developing a detailed understanding of clients' inventions and determining patent filing strategies that align with our clients' commercial objectives
- Drafting patent applications to provide legal protection for our clients' inventions
- Prosecuting those applications in Australia (and often New Zealand) and instructing patent agents in overseas jurisdictions
    - This includes writing detailed technical/ engineering/scientific descriptions of inventions and applying relevant patent laws to arguments
- Ensuring that the filing, examination and renewal related deadlines of IP rights are met
- Working with clients to provide advice relating to freedom to operate
- Providing litigation support to solicitors during contentious proceedings
- Undertaking due diligence reviews of patent portfolios for investors
- Staying up to date with legal developments in IP in major jurisdictions, like Europe and the US
- Mentoring and teaching trainee patent attorneys

So what attracted you to the profession?

Towards the end of my PhD, I was considering options outside of academia and became interested in research commercialisation. It was actually my PhD supervisor who suggested looking into becoming a patent attorney, given my interest in commercialisation and also my skills in technical writing and communication.

Another patent attorney once described the profession to me as an interface between technology, law and business, and I think this is an apt description.

Something that I found (and still find) particularly attractive is the commercial aspect of the role – not only do we do we get to learn about cutting edge research, but we also get to be involved with the commercialisation and translation of the research.

Australian researchers are prolific innovators, and securing patent protection and IP rights are an important part of the process of commercialisation research and ensuring that the broader community benefits from the research output. So I find it's really nice to be able to apply knowledge, experiences and skills which I developed as a researcher in a meaningful way as a patent attorney.

From Researcher to IP Professional: Interview with a Patent Attorney

What did you do to get started in the profession?

Before applying for jobs, I got in touch with some patent attorneys to get a better understanding of what the profession is like. Once I'd decided I was interested, I started looking for jobs towards the end of my PhD (at the Institute for Molecular Bioscience, University of Queensland) around the time of submitting my thesis.

Entry-level patent attorney roles, which go by a number of names including 'trainee patent attorney' and 'patent scientist', are usually advertised on online platforms such as SEEK. I applied for an interstate role online and then went through several interviews via videoconference and in person before being offered a position at my first firm.

Are there particular requirements in order to get a job as a trainee patent attorney? Do you need to have a law degree?

It is not a requirement to have a law degree to get a job as a trainee patent attorney. Firms look to hire trainees for their technical science background and communication skills; the legal skills are usually learnt as part of your training.

It can be an advantage to have some postdoctoral or industry experience and/or experience or training in commercialisation when applying for a position, although this is not a requirement either.

To become a registered patent attorney, you need to fulfil several requirements, including academic qualifications, knowledge requirements and employment requirements.

First, you need to have a qualification and demonstrated technical experience in an area of technology such as life sciences, physics or engineering. As I mentioned earlier, in the life sciences space, the standard of technical experience expected these days tends to be a PhD, but there are no hard and fast rules – there are certainly patent attorneys who do not have a PhD.

In order to become registered, you also need to have demonstrated knowledge in various topics relating to IP. These topics are covered by accredited courses provided at Australian universities, including the University of Melbourne and University of Technology Sydney, as part of a Masters of IP Law. You do not need to have done any of these courses before applying for a trainee patent attorney role; trainees are usually supported by their firms to complete the accredited courses, although this will depend on the firm.

Finally, before registering as a patent attorney, you need to have worked for a total of two years in a role providing suitable experience (eg working as a trainee patent attorney at an IP firm). The registered attorneys where you work are required to sign off on a Statement of Skill, which attests to the specific skills you have developed during the course of your training. This ensures that you have had experience in the key areas of work of a patent attorney, before you become registered.

What skills would you say are important for a patent attorney?

That's a good question because this isn't a job for everyone!

A patent attorney needs to have meticulous attention to detail and have great organisational skills: we deal with lots of deadlines!

Being a patent attorney requires you to communicate complex technical and legal arguments to a variety of audiences. You therefore need to have excellent written and verbal communication skills and the ability to adapt those for your target audience.

Communication needs to be clear, exact and concise: often millions of dollars are spent in litigation disputing the meaning of one or two words in a patent claim! Language skills are a critically important aspect of the job.

What does an average day look like for you?

Most of the day is spent conducting attorney work: drafting applications, preparing arguments for prosecution and preparing advice to clients. This can include discussions with clients and working together with colleagues. Mostly, I spend the day working autonomously, touching base with colleagues or clients as needed.

I usually also spend some time reading recent decisions from the Patent Office or courts, online articles and attending seminars/webinars to keep up to date with things going on in the IP and life sciences industries. Sometimes there are also opportunities to attend external networking events or visit clients, which is something I enjoy doing in the role.

What do you enjoy most about your job?

I find being able to help researchers as part of their journey to commercialise and translate their research to be a really rewarding part of the job. From a more day-to-day perspective, I enjoy the interesting and varied work and being able to interact with different people.

I also like that you are constantly learning new things in the role, no matter how long you have been in the profession. The technology is constantly evolving and we need to keep on top of new advances in different technology areas. It is also important to keep up with changes in patent law in a variety of jurisdictions.

From Researcher to IP Professional: Interview with a Patent Attorney

What would you say is the most challenging part of your job?

When you first start working as a trainee patent attorney, you will typically be working full-time while studying part time, so balancing work and study can be challenging at times. That said, your firm and your colleagues will provide support and help with this, having gone through these experiences before!

An ongoing challenge as a patent attorney is being able to effectively manage time and work while under pressure. This is a deadline-driven industry and deadlines are constantly being set, so being able to effectively manage deadlines is a must. Doing this while at the same time being able to meet the expectations of clients and colleagues can be challenging, but it is valuable skill that you learn and continue to develop on the job.

What advice do you have for someone thinking about becoming a patent attorney?

It can be a rewarding profession, but it's not for everyone! Technical writing and reading is a large part of the role, as well as being able to communicate well with different audiences and having a fine tuned attention to detail.

If you think this sounds like you, and you're interested in commercialisation, this role may be for you! In this case, I would suggest having a chat with some patent attorneys, particularly junior attorneys, to get a flavour for what the job is really like.

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Election of Council 2022

Nominations are called for the following positions on the Council of the Australian Society for Biochemistry and Molecular Biology Inc for 2022: Secretary, Treasurer, Editor, Education Representative, Secretary for Sustaining Members and State Representatives.

The ASBMB Council for the period 1 January 2021 to 31 December 2021 is composed of the following members:	President	J Matthews
	Past President	J Mackay
	Secretary	D Ng #
	Treasurer	M Kvansakul #
	Editor	T Soares da Costa #
	Education Representative	N Samarawickrema §
	Secretary for Sustaining Members	S Jay #
Representatives for:	ACT	C Spry #
	NSW	L Sharpe #
	Vic	L Osellame #
	Qld	M Landsberg #
	SA	M Pitman §
	Tas	I Azimi #
	WA	M Murcha §

Eligible for re-election
§ Position open

Nomination forms are available on the ASBMB website. Nominations for all vacant positions must be signed and seconded by members of the Society. The nominations must be signed by the nominee to indicate his/her willingness to stand. If more than one nomination is received for any position, a ballot will be held at the Annual General Meeting. All members will be notified of any elections and members not attending the Annual General Meeting may submit a proxy form available from the Secretary.

NOMINATIONS MUST REACH THE SECRETARY BY THE AGM IN NOVEMBER 2021 (DETAILS TO BE ADVISED)

Science Teachers' Association of Victoria – Science Talent Search

The Victorian branch of the ASBMB continued its Gold Sponsorship of the annual Science Talent Search in November 2020. As with many events in 2020, this event was held online. The Science Talent Search, founded in 1952, is organised by the Science Teachers' Association of Victoria and is open to all Victorian primary and secondary school students. The aims of this program are:

- Encouraging independent self-motivated project work amongst students of science.
- Giving students the opportunity to communicate their achievements to a wider audience.
- According recognition of effort and achievement for their scientific enterprise.
- Promotion of the direct involvement of the students in the process of science and its communication.
- To give the public at large an opportunity to see the quality of work being achieved in science, by both primary and secondary students.

Students are invited to submit projects under the following categories: Computer Programs, Games, Science Photography, Posters and Scientific Wall Charts, Working Models, Inventions, Experimental Research, Creative Writing, Video Productions and for primary students, Class Experimental Research Project. In 2020, 127 schools participated with 1,940 students involved. This was a fantastic turnout given the event was held online rather than in person at La Trobe University.

The Victorian branch of the ASBMB once again supported the event with a $1,000 donation in the form of minor and major bursaries to students from the following Victorian schools: Holy Rosary School, McKinnon Secondary College, Sirius College, Strathcona Baptist Girls Grammar School and Templestowe Park Primary School. Project titles included: 'What happens to your body when you have an allergic reaction to food?', 'How temperature affects yeast', 'The effect of freezing time on tofu hydrophilicity', 'Cheesy delight: producing the highest amounts of curds in cheese using different vinegars', 'The effect of plant cell membrane damage in both acidic and alkaline environment'. These are such wonderful avenues of investigation from some of our budding young scientists, so much so that there is still much to learn about some of these topics!

Students from Sirius College working on their entry which was awarded a bursary from the ASBMB.

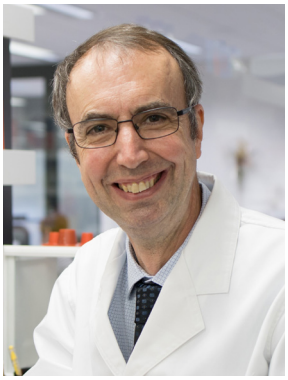
ASBMB Victoria is proud to sponsor this event annually. Investment in the future and the future of young scientists here in Australia is vital. Looking through the 2020 program and seeing the sheer number of students and wonderful ideas they put forward, in what was a very challenging year for many students, is a testament to their resilience. Hopefully this small taste of scientific research inspires them to continue their journey in science.

Laura Osellame
ASBMB Victorian State Representative
www.sciencevictoria.com.au/sts

ASBMB Medallist and Awardee Profiles

The Lemberg Medal is awarded to a distinguished Australian biochemist or molecular biologist who will present the Lemberg Lecture at the annual ASBMB conference. The Medal is presented in memory of Emeritus Professor MR Lemberg, who was the Society's first President and Honorary Member. Nominees must have been members of the Society for at least five years before the year in which the Medal nomination is to be considered. An honorarium is provided by ASBMB.

The Lemberg Medal
Merlin Crossley



Merlin Crossley became interested in gene regulation as an undergraduate in Jim Pittard's lab at the University of Melbourne. He moved to Oxford for his doctorate, supported by a Rhodes Scholarship, and investigated the regulation of the clotting factor IX gene in George Brownlee's lab. He worked on some unusual cases of haemophilia that resolved after puberty, producing papers in *Nature* and *Science*. The mutations were among the first ever human regulatory mutations, and the studies showed how single point mutations could dramatically alter developmental gene expression.

Crossley moved to Stu Orkin's lab in Harvard and investigated the developmental regulation of the globin genes. He identified a new transcription factor Kruppel-like Factor 3 (KLF3), and contributed to the cloning of the essential GATA-1 co-regulator Friend of GATA (FOG/ZFPM1). On returning to a lectureship at the University of Sydney, he worked on identifying several new gene regulatory proteins including co-regulators CtBP2 and FOG2, and new zinc finger transcription factors, EOS (IKZF4), PEGASUS (IKZF5), KLF8 and KLF17. He also began a long running collaboration with Joel Mackay and Jacqui Matthews, resulting in the determination of the structure of several zinc finger complexes.

In 2010, he became Dean of Science at the University of New South Wales (UNSW) and focussed on natural mutations that derepressed the expression of foetal globin and cause hereditary persistence of foetal haemoglobin (HPFH). This condition is beneficial when coinherited with sickle cell disease or thalassemia. His recent work, published in *Science, Nature Genetics, Nature Communications, Blood* and *Trends in Genetics*, demonstrated that the HPFH mutations either disrupted binding sites for repressors or generated *de novo* binding sites for activators. These studies suggested a new gene therapy strategy that involves introducing the mutations via CRISPR gene editing to boost foetal globin production to alleviate sickle cell anaemia or thalassemia, rather than adding a replacement gene.

In 2016, Crossley began leading teaching at UNSW as Deputy Vice-Chancellor Academic. He continues to teach while maintaining his research. Throughout his career he has been recognised for the quality of this research with prizes, including the Edward Chapman Award (Magdalen College, Oxford), Gottschalk Medal (Australian Academy of Science), Julian Wells Medal (Lorne Genome), Edgeworth David Medal (Royal Society of NSW), Roche Medal (ASBMB) and in 2020, the NSW Premier's Prize for Medical Biological Sciences. He also supports science and science communication as Chair of the Editorial Board of *The Conversation*, Director of the UNSW Press Board, Deputy Director of the Australian Science Media Centre and as a member of the Australian Museum Council of Governors. He has also held roles on the ASBMB Council and currently uses social media, blogging and twitter, to engage with and help build the community of scientists.

ASBMB Medallist and Awardee Profiles

The Shimadzu Research Medal is awarded to an outstanding Australian biochemist or molecular biologist with less than 15 years postdoctoral experience. The successful candidate will present the Shimadzu Medal Lecture at the ASBMB annual conference. Nominees must have been members of the Society for at least two years before the year in which the Medal nomination is to be considered. An honorarium is provided through the courtesy of Shimadzu.

The Shimadzu Research Medal
Erinna Lee

Dr Erinna Lee heads the Cell Death and Survival Laboratory and is Cancer Theme Leader at the La Trobe Institute for Molecular Science (LIMS), and is a visiting scientist at the Olivia Newton-John Cancer Research Institute (ONJCRI).

Erinna was awarded her PhD in 2007. Under Professor Peter Colman and Associate Professor Douglas Fairlie at WEHI, she explored the molecular landscape dictating interactions between the BCL-2 family of apoptotic cell death regulators. Using a multi-faceted approach combining biochemistry, cell biology and structural biology, she made significant contributions to our understanding of the therapeutic value of targeting BCL-2 proteins in cancer, and developed novel, highly-stable pro-apoptotic 'non-natural' peptides. Tools she developed were applied as benchmark regents at Genentech, AbbVie and Servier, and she was a member of the WEHI/Genentech/AbbVie collaboration that led to clinically approved drugs targeting BCL-2 proteins.

During her postdoc at WEHI, she pursued her discovery of BCL-2 pathways in disease-causing parasites. This raised the notion of repurposing BCL-2 protein-targeting drugs as anti-infectives, leading to a drug discovery program with WEHI collaborators and recent publication of the first lead compounds targeting this pathway in parasites. Related evolutionary studies in nematodes led to the detailing of apoptosis pathways in over 80 species.

Since establishing her group at LIMS/ONJCRI in 2016, Erinna leads programs on the clinical application of BH3-mimetics in incurable cancers and collaborates with pharmaceutical companies (e.g. AbbVie, AstraZeneca) to develop tumour cell-specific BCL-2-targeting drugs. Recent findings on targeting BCL-2 proteins in mesothelioma has provided a basis for developing a phase I clinical trial. She collaborates extensively with national industry partners (Phylogica, PharmAust, Noxopharm), investigating their anti-cancer drugs.

Erinna has published over 60 articles in journals including *Genes and Development, PNAS, Angewandte Chemie, Journal of Cell Biology* and collaborations resulted in publications in *Science, Cell* and *Molecular Cell*. Erinna currently holds a Victorian Cancer Agency Mid-Career Fellowship and was a recipient of the 2016 ARC Future Fellowship, 2015 Thomson Reuters Citation Award, 2012 NHMRC Career Development Fellowship, 2012 ASBMB Life Technologies Edman Award, 2010 Victorian Young Tall Poppy Award, 2009 Leukaemia Foundation Philip Desbrow Fellowship, 2008 Lorne Proteins Young Investigator Award, 2007 Victoria Fellowship, 2007 ASBMB Fellowship and 2006 ASMR Campion-Ma-Playoust Award. She was nominated a Luminary in the Australian Cell Death Society, recognising members who have shaped cell death research in Australia. She served as the ASBMB Victorian State Representative and on the *Australian Biochemist* Editorial Committee 2017–2020.

ASBMB Medallist and Awardee Profiles

The SDR Scientific Education Award rewards outstanding achievement in education in biochemistry or molecular biology, especially innovation and creativity in education, with a view to fostering leadership in this important area of the Society's objectives. The Award will enable the recipient to participate in an international conference with a significant focus on education, or to spend a period of time at another institution (in Australia or overseas) for the purposes of undertaking developments in education in biochemistry and molecular biology. The recipient will present a lecture within the Education Symposium at the ASBMB annual conference. Applicants must have been members of the Society for at least two years before the year in which the Award application is to be considered. The contribution to travel expenses is provided through the courtesy of SDR Scientific.

SDR Scientific Education Award
Lois Balmer

My students are my priority and teaching excellence is something about which I am passionate. I feel excited and privileged to be contributing to the next generation of scientists. I have grown to understand that excellence in teaching involves constantly reevaluating what I am teaching and how I am teaching. I am always striving for the most creative and effective methods to maximise student learning, engagement, enjoyment, and success. The positive feedback from my students is humbling and motivates me to do even better. My dedication to teaching is demonstrated by being awarded a 2018 Vice-Chancellor's Staff Award for outstanding contribution to student learning and being nominated by my university in both 2018 and 2019 for an Australian Award for University Teaching.

Just as my teaching is an integral part of who I am, so too is my research. I am a geneticist with a focus on the complications and genetics of diabetes. I have published widely in high impact factor journals (including *Kidney International, Immunology, Nature Regenerative Medicine, Nephrology* and *eLife*) in addition to supervising four PhD and Honours students to completion. I have won awards such as the Medical Science Week 'Minute-to-pitch-it' and the Medical Research Foundation Young Investigators Oral Prize and been successful in grant funding.

With the completion of my PhD in 2005 from the University of Western Australia in the field of cancer, I moved to my first postdoctoral position. During this time, I was exposed to a brand-new experience – that of undergraduate teaching. Since 2006, I have demonstrated for undergraduate molecular biology students at Edith Cowan University. While demonstrating, a senior lecturer noticed my dedication to students and how they experienced their learning. Unbeknownst to me, he started me on a journey to where I am today. My teaching journey has progressed from demonstrator, tutor, lecturer to overall Unit Coordinator. I have been employed as a lecturer on a teaching and research path at Edith Cowan University since 2014 and in 2019, I was promoted to Senior Lecturer.

I feel privileged to have been able to bring a research–teaching nexus perspective to my students by engaging with my network of research professionals. Further, I believe through the community-based initiative I have introduced, I have been able to bring a human-centred compassionate focus to students' appreciation of their learning and future careers. Going forward, I hope and trust that the ripple effects of these transformational learning experiences will impact on the community in positive and meaningful ways.

ASBMB Medallist and Awardee Profiles

The Eppendorf Edman ECR Award is awarded to an ASBMB member with no more than seven years postdoctoral experience (or equivalent taking any career disruption into account), in recognition of their outstanding research work. The Award provides funds to assist the recipient to attend an overseas conference in a field associated with biochemistry or molecular biology or to visit briefly a research laboratory in Australia or elsewhere to access specialised equipment or to learn new research techniques. The recipient will present a lecture within a symposium at the ASBMB annual conference. Applicants must have been members of the Society for at least two years before the year in which the application is to be considered, or must have taken out a three year membership in the year of the application. The contribution to travel expenses is provided through the courtesy of Eppendorf South Pacific.

Eppendorf Edman ECR Award
Lahiru Gangoda

Dr Lahiru Gangoda completed a BSc in Biochemistry and Molecular Biology at the University of Colombo, Sri Lanka. Following her undergraduate degree which sparked her interest for biomedical research, she moved to Australia and undertook a Master's degree at La Trobe University in Professor Leann Tilley's laboratory. Lahiru then joined the laboratory of Professor Nicholas Hoogenraad as a research assistant. During this time, she gained skills in monoclonal antibody production and screening. In 2011, Lahiru began her doctoral studies under the supervision of Associate Professor Hamsa Puthalakath at La Trobe University. Lahiru's PhD research was based on mouse tumour models to investigate the role of cell death proteins in Carney complex syndrome. Her PhD resulted in six original research articles, including two first author publications in *Cell Death and Differentiation* and *Cell Death and Disease*.

In 2014, Lahiru joined the laboratory of Professor Suresh Mathivanan at La Trobe University and started working on a project to overcome chemotherapy drug resistance in colorectal cancer. During this time, she gained expertise in extracellular vesicle research. In 2016, she was awarded a prestigious Victorian Cancer Agency Early Career Seed Grant to support her research. Lahiru was the recipient of the La Trobe University's Research Excellence by an Early Career Researcher Award in 2016 in recognition of her research contributions. Her 4-year postdoctoral position under the mentorship of Professor Mathivanan resulted in 16 publications including seven first author articles. She was involved in teaching, supervision and mentoring of high school, undergraduate and postgraduate students during her time at La Trobe University.

In 2018, Lahiru joined the laboratory of Associate Professor Marco Herold at the Walter and Eliza Hall Institute as a Senior Postdoctoral Fellow. She has been working on several projects investigating the role of cell survival proteins in cancer and inflammation. She was awarded a CASS Foundation Science and Medicine Grant in 2020 to investigate methods to overcome treatment resistance in melanoma by blockage of cell survival proteins. Lahiru has presented her research findings at more than 20 national and international conferences and have received numerous awards in recognition of her work. The Eppendorf Edman ECR Award will allow Lahiru to attend an international conference and present her latest research.

ASBMB Medallist and Awardee Profiles

The Boomerang Award is offered to an outstanding expatriate Australian biochemist or molecular biologist to provide an opportunity to return to Australia to present their work in a Symposium at the annual ASBMB conference and to give seminars at universities or research institutes in at least one other Australian city. The Award is intended to provide the awardee with exposure in Australia and to facilitate interactions with local researchers. Applicants must have been a member of a recognised Australian scientific society for at least two years, or must have taken out a three year membership in the year of the application, and awarded their PhD not more than ten years prior to the closing date (or equivalent taking any career disruption into account). The contribution to travel expenses is provided by ASBMB.

Boomerang Award
Anton Calabrese

Anton completed his undergraduate studies at the University of Adelaide in 2008, where he also studied for a PhD with Professor John Bowie and Associate Professor Tara Pukala. It was during his postgraduate studies that Anton developed a passion for structural mass spectrometry (MS), realising the power of this technology in integrative structural biology. His PhD work focused on developing new structural MS tools (including new crosslinking-MS approaches) and applying structural MS to interrogate biological mechanisms (for example, antimicrobial peptide self-assembly). Anton's PhD studies contributed to 13 research articles.

After completing his PhD in 2013, Anton joined the Astbury Centre for Structural Molecular Biology at the University of Leeds, taking up a postdoctoral researcher position in the laboratories of Professors Alison Ashcroft, Sheena Radford and Peter Henderson. During his postdoctoral studies, he developed MS methods to study the architecture/interactions of membrane proteins by native-MS/covalent labelling, and established the first European platform for fast photochemical labelling of proteins (FPOP)-MS. Inspired by challenges in understanding the structure, function and dynamics of membrane proteins, Anton was a co-applicant on a successful Biotechnology and Biological Sciences Research Council grant to study the folding pathway of outer membrane proteins (OMPs) from Gram-negative bacteria, combining structural-MS, cryo-EM, FRET and biochemical/computational data. This work has resulted in new insights into the functional mechanisms of the periplasmic chaperones Skp and SurA (published in *Nature Structural and Molecular Biology* in 2016, *Angewandte Chemie* in 2018 and *Nature Communications* in 2020) and the architecture of the essential BAM complex (*Nature Communications*, 2016). These studies have provided important new insights into the journey of unfolded OMPs through the periplasm and are inspiring new avenues by which this essential pathway could be targeted to develop antibiotics.

In 2020, Anton was awarded a University Academic Fellowship in the School of Molecular and Cellular Biology and the Astbury Centre for Structural Molecular Biology at the University of Leeds to establish an independent research group. He was also awarded a prestigious Sir Henry Dale Fellowship, jointly funded by the Wellcome Trust and Royal Society. His independent research is focused on deploying structural MS methods (including in-cell structural MS), along with other biophysical, biochemical and cellular tools, to study biomolecular condensates involved in viral replication, and the molecular events underlying aberrant phase transitions associated with neurodegenerative disease.

Anton is convinced that structural MS technologies will play an increasingly important role in interdisciplinary research going forward, and is excited to see what future developments will enable. He thanks the ASBMB for this exciting opportunity to present his work at an upcoming ASBMB meeting and to visit laboratories in Australia, including in Canberra and Adelaide.

ASBMB Fellowship Profiles

The ASBMB Fellowships are awarded annually to biochemists or molecular biologists, in their early career and normally resident in Australia, in recognition of their outstanding work in an area of biochemistry and molecular biology.

The Fellowships provide funds to assist the recipient to attend an overseas conference in a field associated with biochemistry or molecular biology or to briefly visit a research laboratory in Australia or elsewhere to access specialised equipment or to learn new research techniques.

Applicants must be at least in the second year of PhD training and not more than two years subsequent to the award of the PhD degree. Applicants must have been members of the Society for least one year immediately prior to application.

The Collins family kindly established the Fred Collins Award to honour the role that Fred Collins played in the establishment of the Australian Biochemical Society.

Pamali Fonseka – recipient of the Fred Collins Award for the most outstanding ASBMB Fellowship applicant

Pamali Fonseka completed a Master in Biotechnology at La Trobe University. Later, Pamali was awarded a PhD scholarship from La Trobe University to continue her research under the supervision of Professor Suresh Mathivanan. During her PhD, Pamali investigated the key regulators of neuroblastoma aggressiveness using cell and molecular biology, biochemical techniques, and proteomics. She discovered that by modulating the cellular lineage, treatment resistant aggressive neuroblastoma cells can be sensitised to standard-of-care chemotherapeutic drugs. After completion of her PhD in 2018, Pamali started her postdoctoral research investigating the role of extracellular vesicles in cancer progression. In 2019, she was awarded a CASS Foundation Medicine/Science grant as sole CI to investigate novel strategies to combat high-risk neuroblastoma. Pamali has more than 15 publications and book chapters in journals including *Nature Communications*, *Nucleic Acids Research*, *Journal of Extracellular Vesicles* and *Nature Immunology*. Pamali has received several travel awards which she utilised to present her work in international conferences. She won the best oral presentation award (one of three awarded) in International Society of Extracellular Vesicles 2020 conference. She is an Editor of the Springer book series *Next Frontiers: Extracellular Vesicles* and Associate Guest Editor of a *Cells* special issue in 2021.

Pamali will use this fellowship to visit Professor Paul Timpson's laboratory at Garvan Institute of Medical Research in Sydney to learn organotypic collagen invasion assay, which will aid her in shortlisting drugs that can be examined later in pre-clinical models of neuroblastoma.

Edward Kerr

I completed a Bachelor of Science in 2015 with a dual major in Genetics and Computational Science at the University of Queensland. Following this, I completed Honours in Genetics from the School of Chemistry and Molecular Biosciences at the University of Queensland in 2016, obtaining First Class Honours. My PhD was at the University of Queensland with Associate Professor Benjamin Schulz in collaboration with Newstead Brewing Co and supported by the Advance Queensland initiative supporting university and business collaborations. During my PhD, I used omics-based approaches including proteomics, metabolomics and genomics to better understand underlying biochemical variability in the beer brewing process and improve process efficiency and product quality. Most interestingly, this included discovering novel wild yeasts from around Brisbane for use in beer fermentation. In 2021, I started as a Postdoctoral Research Fellow with Associate Professor Schulz continuing my work on brewing biochemistry and starting work on fundamental glycosylation in yeast. Since starting my PhD in 2017, I have published four first author papers, one book chapter and several publications as co-author. I have been awarded two conference prizes, and presented my research to both my peers at scientific conferences and to the general public at Australia's Pint of Science.

The ASBMB Fellowship will allow me to attend the Human Proteome Organisation World Congress 2021 in Stockholm, where I will present my novel research on proteomic, metabolomic and genomic characterisation of native Australian yeast for beer brewing.

ASBMB Fellowship Profiles

Abi Ghifari

Abi Ghifari completed his Bachelor of Science (Chemistry) at University of Indonesia, followed by a Master of Science (Biochemistry and Molecular Biology) with distinction from the University of Western Australia (UWA) in 2018. During this time, under the mentorship of Dr Monika Murcha, he investigated protein import-associated peptide processing pathways in plant mitochondria, leading to a publication in *Biochemical Journal*. He then joined the laboratory of Professor Makoto Arita at RIKEN Centre for Integrative Medical Sciences, Japan for a three-month research internship. Shortly after, he was awarded the Australian Government Research Training Program and University Postgraduate Award to pursue a doctoral degree in the same laboratory at UWA. His PhD projects focuses on functional investigation of plant mitochondrial peptidases mainly involved in peptide degradation and respiratory complex disassembly using combined techniques of protein biochemistry, proteomics, molecular biology and cell biology. Now entering his third year, his work has been published as a first-authored paper in *The Plant Journal*, a comprehensive review in *Journal of Experimental Botany*, a chapter in *Encyclopedia of Life Sciences*, and a second-authored paper in *Plant Physiology*. Abi was also a recipient of Australian Society of Plant Scientists (ASPS) Travel Award to present his research at the 2019 ASPS Conference in Melbourne. He is the treasurer of the Perth Protein Group, an ASBMB Special Interest Group for protein researchers in Western Australia.

The ASBMB Fellowship will allow Abi to present his work at the 12th International Conference for Plant Mitochondrial Biology 2022, which will be held in Malmö, Sweden.

Belal Shohayeb

Dr Belal Shohayeb completed a Bachelor's degree (2013) at Pharos University in Alexandria, Egypt. He then moved to the UK to attain a Master of Research in developmental biology at the University of Nottingham. Belal undertook his PhD (2016–2020) at the School of Biomedical Sciences, the University of Queensland (UQ), in the laboratory of Associate Professor Dominic Ng, where he investigated patient-derived mutations in WDR62, a microcephaly-associated protein. He discovered novel molecular functions of WDR62 in cilia formation, a sensory organelle essential for normal brain development, by recruiting tubulin transporter proteins at the cilia basal body required for cilia elongation. His research contributed significantly to understanding the underlying molecular mechanisms of WDR62 pathogenic mutations during brain development, reflected in the six papers published during his PhD in journals including *Stem Cell Reports* and *Human Molecular Genetics*. Two of his publications received the best publication award of the year from the School of Biomedical Sciences, UQ, in 2018 and 2019. The excellence of his research has been recognised by awards from the European Molecular Biology Laboratory and the International Union of Biochemistry and Molecular Biology. Recently, he joined Queensland Brain Institute as a postdoctoral research fellow in the laboratory of Professor Helen Cooper, where he developed an interest in autism-associated mutations in postsynaptic adhesion proteins and their implication on actin polymerisation and synaptic morphogenesis.

The ASBMB Fellowship will allow Belal to present his recent findings in a Cold Spring Harbour Meeting, Autism from Genetic Discoveries to Interventions, where he can develop new collaborations and learn about new techniques.

Australian Society for Biochemistry and Molecular Biology Inc
PUBLICATION SCHEDULE FOR *AUSTRALIAN BIOCHEMIST*, volume 52, 2021

Issue	ASBMB Content	Copy Deadline	Issue Date
April 2021 52(1)	Profiles of medal, award and fellowship winners Nominations for Executive/Council	Monday 8 February	Monday 5 April
August 2021 52(2)	Nominations for medals, awards and fellowships Notice of AGM/proposed constitutional changes	Monday 7 June	Monday 2 August
December 2021 52(3)	Annual reports FAOBMB/ASBMB conference report	Monday 4 October	Monday 6 December

Australia Day Honours for ASBMB Members

Professor Peter Leedman was awarded an Officer of the Order of Australia (AO) for distinguished service to medicine, health and medical research as a physician-scientist, to professional societies and to tertiary education.

Peter is the Director of the Harry Perkins Institute of Medical Research (Perkins) in Perth, Head of the Perkins Laboratory for Cancer Medicine and Professor of Medicine at the University of Western Australia (UWA). He completed his PhD at the Walter and Eliza Hall Insitute working on the molecular mechanisms of Graves' disease and a postdoc at Harvard, where he developed an interest in RNA biology and the regulation of hormone action in cancer. He returned to Perth in the mid-1990s to an academic post at UWA.

His team's discovery of several novel RNA-binding proteins that function as key coregulators of nuclear receptor action has provided new insight into hormone action. His long-term interest in ncRNAs, in particular microRNAs (miRs), has driven studies to harness miRs for therapeutics in poor prognostic tumors (liver, head and neck).

His team has shown miR-7 to be a potent tumour suppressor and an ideal target for therapeutics. Peter co-founded miReven, a biotechnology company developing miR-7 as a replacement therapy for cancer, and is driving this initiative towards an early phase clinical trial in patients with liver cancer.

Together with Professor Peter Klinken, he co-founded the Western Australian Institute for Medical Research in 1998 (which would later become the Perkins). He is Chairman of Linear Clinical Research Ltd, an award-winning 24-bed early phase clinical trials facility, a wholly owned subsidiary of the Perkins. He is a Fellow of the Australian Academy of Health and Medical Sciences and has served on numerous committees, including Chair of the Sylvia and Charles Viertel Medical Advisory Committee for over ten years.

Professor Roger Reddel was awarded an Officer of the Order of Australia (AO) for distinguished service to biomedical research in the field of adult and childhood cancer and genetics, and to tertiary education.

Roger is currently the Lorimer Dods Professor and Director, Children's Medical Research Institute (CMRI), Faculty of Medicine and Health, University of Sydney. Roger's research career began with an Honours year in Biochemistry (BSc Med) at the University of Sydney. After completing Medicine (MBBS), he trained as a specialist physician (FRACP) in medical oncology. Roger then undertook a PhD in cancer cell biology (also University of Sydney) and was awarded a CJ Martin Fellowship from NHMRC and a Fulbright Fellowship to undertake postdoctoral research in molecular biology of cancer at the US National Cancer Institute (NCI) in Bethesda, Maryland.

After a period as an NCI staff member, he returned to Sydney as the Cancer Council NSW Bicentennial Fellow, and set up CMRI's Cancer Research Unit. His research at CMRI investigates the unlimited replicative potential ('immortalisation') of cancer cells. He and his team are known internationally for discoveries regarding the role of telomere length maintenance in immortalisation, and especially the discovery of the Alternative Lengthening of Telomeres mechanism. He is also a co-founder of the ProCan program, which is focussed on delivering proteogenomic data to the cancer clinic. A Fellow of the Australian Academy of Science and of the Australian Academy of Health and Medical Sciences, Professor Reddel has been awarded the Ramaciotti Medal, the NSW Premier's Award for Outstanding Cancer Researcher, and the Neil Hamilton Fairley Medal of the Royal Australasian College of Physicians.

Yeast SIG: an ASBMB Special Interest Group

The Yeast SIG was established in 2005 with the purpose of assembling Australia's yeast researchers prior to bringing the International Conference on Yeast Genetics and Molecular Biology to Australia for the first time in 2007. The Yeast SIG office bearers are Alan Munn (Griffith University) (President), Birgitta Ebert (University of Queensland) (Treasurer) and Ben Schulz (University of Queensland) (Secretary). Birgitta was elected in 2020 when James Fraser stepped down. Thanks to James for his valuable contribution as Treasurer for many years.

The main activity of the Yeast SIG is organising the biennial Yeast: Products and Discovery (YPD) meeting. The most recent YPD meeting was held at the University of Sydney from 4–6 December 2019 (YPD2019). YPD2019 was the most well-attended YPD meeting to date with 109 registrants. The YPD2019 local organising committee included Dee Carter (Chair) and Aidan Kane (University of Sydney), Justin Beardsley (Marie Bashir Institute (MBI), University of Sydney), Oliver Morton (Western Sydney University (WSU)), Marc Wilkins (UNSW) and Heinrich Kroukamp (Macquarie University).

The ASBMB kindly provided financial assistance for student travel to YPD2019. Other YPD2019 sponsors were the Marie Bashir Institute, the Australian Society for Microbiology, the Australasian Mycological Society, AB Biotek and the Ramaciotti Centre for Genomics.

The program organising committee was chaired by Julianne Djordjevic (Centre for Infectious Diseases and Microbiology (CIDM), Westmead Institute for Medical Research (WIMR) and MBI, University of Sydney). Members included Laszló Irinyi and Vanessa Rossetto Marcelino (CIDM, WIMR), James Fraser and Benjamin Schulz (University of Queensland), Traude Beilharz and Jiyoti Verma (Monash University), Austen Ganley (University of Auckland), Simon Schmidt and Anthony Borneman (Australian Wine Research Institute (AWRI)), Alex Andrianopoulos (University of Melbourne), Oliver Rackham (Perkins Institute and Curtin Health Innovation Research Institute (CHIRI), Curtin University) and Evelyn Sattlegger (Massey University).

Left: Attendees chatting over coffee and viewing posters during a break.

Below: YPD2019 conference dinner at the Great Hall, University of Sydney.

Speakers came from academic, commercial and government laboratories around Australia and New Zealand to take part in this meeting.

Topics covered included:

- Building the world's first functional synthetic eukaryotic genome: Plenary lecture (S Pretorius, Macquarie University)
- Creating new industrial yeast for the biofuel (P Bell, Microbiogen) and the cosmetic industry (V Haritos, Monash University)
- Understanding the Indigenous yeast present in Australian Aboriginal fermentations (C Varela, AWRI)
- Understanding the role of yeast and fungi in the microbiome by developing a novel *in vitro* model to study *C. albicans* colonisation of the human colon (M Lenardon, UNSW) and developing novel metagenomics approaches to overcome the challenges of identifying fungi in the human microbiome (V Rosetto Marcelino, MBI)
- Developing antifungal surface coatings for preventing biofilm formation (BR Coad, University of Adelaide)
- Tackling the global threat posed by life-threatening invasive yeast infections, including *Candida auris*, the first yeast 'superbug' causing great concern in British and North American hospitals and recently emerged in Australia (R Cannon, University of Otago, C Simm, Monash University, and J McKenna, La Trobe University)
- Developing new antifungals (L Guddat, University of Queensland, and L Wilkinson-White, Sydney Analytical, University of Sydney)
- Determining the impact of fungal plant diseases on food security (D Guest, University of Sydney)
- Using infection models to study the interaction between *Aspergillus fumigatus* and the host (O Morton, WSU)
- Understanding DNA repair systems (A Idnurm, University of Melbourne), chromatin dynamics (J Verma, Monash University) and inflammasome activation and metabolic control of innate immunity (T Tucey, Monash University) during fungal infection
- Proteomic characterisation of *S. cerevisiae* and *C. albicans* extracellular vesicles to identify biomarkers and a potential role in antifungal drug tolerance (M Bleackley, La Trobe University)
- Using microbes to synthesise psilocybin from 'magic' mushrooms, a compound being investigated as a

Yeast SIG: an ASBMB Special Interest Group

treatment for depression, addiction and post-traumatic stress disorder (N Coleman, University of Sydney)

- Elucidating the biosynthetic potential of fungi to accelerate the discovery of bioactive molecules by developing episomal expression systems for rapid reconstruction and elucidation of cryptic fungal biosynthetic pathways (Y-H Chooi, University of Western Australia)
- Using yeast to discover next generation tools for manipulating genes (O Rackham Perkins, CHIRI)
- Using crosslinking mass spectrometry to comprehensively characterise the protein–protein interaction network (interactome) in yeast nuclei (M Wilkins, UNSW)
- Understanding how dispersal, environmental variability and competition shape metabolic potential of wild nectar yeasts (M Dhami, Manaaki Whenua Landcare Research, New Zealand)
- Assessing fungal diversity of Australian tree hollows in connection to the *Cryptococcus gattii* and *C. neoformans* species complexes (L Irinyi, WIMR)
- Understanding how the human pathogenic fungus, Talaromyces marneffei, adapts to the host niche through cell shape control (A Andrianopoulos, University of Melbourne)
- Building Rube Goldberg machines in yeast to explore unnecessary complexity in biology (A Ganley, University of Auckland)
- Understanding the challenges of membrane protein research in *S. cerevisiae* (E Lamping, University of Otago)
- Determining whether SO_2 tolerance in *Brettanomyces bruxellensis* is a developing concern in the wine industry (A Borneman, AWRI)

The early career researcher award, which enables the successful recipient to attend the next ASBMB meeting, was awarded to Nikolay Shirokikh (John Curtin School of Medical Research, ANU) who spoke about 'Rapid RNA-level responses to stress as revealed by translation complex profile sequencing in yeast'.

Alan Munn (left) with Yeast SIG ECR awardee Nikolay Shirokikh.

Enjoying some yeast products during the microbrewery tour.

The conference also showcased the important work of PhD students with an afternoon dedicated to lightning presentations and follow-up poster sessions chaired by Justin Beardsley. The lightning presentations were judged by the audience via a QR code registration system. From a total of 28 presentations, five prizes were awarded for best poster to: Paige Erpf (University of Queensland), 'Identification and characterisation of sPEPs in *C. neoformans*'; Ryan Separovich (UNSW), 'The role of upstream phosphorylation in the regulation of histone methylation'; Christina Stephenson (University of Queensland), 'The *Cryptococcus neoformans* SAGA: the epigenetic impact of the transcriptional coactivator on virulence in a global fungal pathogen'; Aidan Kane (University of Sydney), 'Using bisphosphonates to overcome azole resistance in *Candida*' and Monica Espinosa (Macquarie University), 'Methanol assimilation in native and synthetic strains of *Saccharomyces cerevisiae*'. A prize for the best lightning talk was also awarded to Kenya Fernandes (University of Sydney), 'Lactoferrin and amphotericin B synergise against yeasts'.

A wine tasting and networking session, featuring a combination of commercial and experimental wines, was held in the quadrangle, followed by dinner in the Great Hall at University of Sydney. Conference delegates visited breweries in Marrickville followed by a networking dinner at the Imperial Hotel, Erskineville.

Julianne Djordjevic and Alan Munn
Email a.munn@griffith.edu.au
Web www.ayeastgroup.org

ASBMB Annual Reports

Executive Officers' Report

Your Executive Officers submit herewith the financial statements of the Association for the year ended 30 June 2020, together with the Auditors' Report thereon and in accordance with Section 73 of the Associations Incorporation Act 1991 report as follows.

EXECUTIVE OFFICERS

The Executive Officers throughout the year were: Professor Joel Mackay (President); Professor Leann Tilley (Past President); Professor Jacqui Matthews (President Elect); Professor Briony Forbes (Secretary); Professor Marc Kvansakul (Treasurer); Dr Tatiana Soares da Costa (Editor and Chair of Communications); Associate Professor Terrence Piva (FAOBMB Representative).

PRINCIPAL ACTIVITIES

The principal activity of the Association in the course of the financial year was the advancement of the science and profession of both biochemistry and molecular biology.

OPERATING RESULTS

During the year, the Association produced an operating loss of $66,473 (2019: operating profit $45,455).

STATEMENT BY EXECUTIVE OFFICERS

In the opinion of the Executive Officers the financial statements, consisting of the Statement of Profit and Loss and other Comprehensive Income, Statement of Financial Position, Statement of Changes in Equity, Statement of Cash Flows and Notes to and forming part of the Financial Statements:

(a) Presents a true and fair view of the financial position of the Association as at 30 June 2020 and its performance for the year ended on that date in accordance with Australian Accounting Standards – Reduced Disclosure Requirements.

(b) At the date of this statement, there are reasonable grounds to believe that the Association will be able to pay its debts as and when they fall due.

Signed in accordance with a Resolution of the Executive Officers.

Professor Joel Mackay, President
Professor Marc Kvansakul, Treasurer

Independent Auditor's Report

REPORT ON THE FINANCIAL STATEMENTS

We have audited the financial report of the Australian Society for Biochemistry and Molecular Biology Incorporated (the association) which comprises the statement of financial position as at 30 June 2020, the statement of profit or loss, statement of comprehensive income, statement of changes in equity and statement of cash flows for the year then ended, notes comprising a summary of significant accounting policies and other explanatory information, and the certification by members of the committee on the annual statements giving a true and fair view of the financial position and performance of the association.

EXECUTIVE OFFICERS' RESPONSIBILITY

The committee of the association are responsible for the preparation and fair presentation of the financial statements in accordance with Australian Accounting Standards – Reduced Disclosure Requirements and the Associations Incorporations Act 1991, and for such internal control as the directors determine is necessary to enable the preparation of a financial report that is free from material misstatement, whether due to fraud or error.

BASIS FOR OPINION

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Report section of our report. We are independent of the association in accordance with the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110: Code of Ethics for Professional Accountants (the Code) that are relevant to our audit of the financial report in Australia. We have also fulfilled our other ethical responsibilities in accordance with the Code.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

AUDIT OPINION

In our opinion, the accompanying financial report of the Australian Society for Biochemistry and Molecular Biology Incorporated is in accordance with the Associations Incorporation Act 1991 including:

(i) giving a true and fair view of the association's financial position as at 30 June 2020 and of its performance for the year then ended; and

(ii) that the financial records kept by the association are such as to enable financial statements to be prepared in accordance with Australian Accounting Standards – Reduced Disclosure Requirements.

IMPACTS OF COVID-19 ON THE ASSOCIATION

The COVID-19 virus has resulted in the Association postponing ComBio2020 to September 2022, and the event is now officially called ComBio2022. Any revenue collected in advance and costs incurred in planning and organising the event have been carried forward to the future event.

The Executive Officers have assessed the Association's ability to continue as a going concern in light of the impacts that the COVID-19 virus has had on the operations of the Association and the community that the Association operates in. Although some aspects of the Association's operations have been impacted by the virus, the Executive Officers are of the opinion that the Association is able to continue as a going concern.

Given the uncertainty of the potential future impacts of the virus on the economy, there is some uncertainty to the future impacts that the virus may have on the operations of the Association.

MC Andreassen (Partner)
Priestleys Chartered Accountants

ASBMB Annual Reports

AUSTRALIAN SOCIETY FOR BIOCHEMISTRY AND MOLECULAR BIOLOGY INCORPORATED

STATEMENT OF FINANCIAL POSITION AT 30 JUNE 2020

	2020 $	2019 $
CURRENT ASSETS		
Cash and cash equivalents	436,615	506,183
Trade and other receivables	70,729	83,808
Other current assets	286	4,073
TOTAL CURRENT ASSETS	**507,630**	**594,064**
NON-CURRENT ASSETS		
Property, plant and equipment	-	-
TOTAL NON-CURRENT ASSETS	**-**	**-**
TOTAL ASSETS	**507,630**	**594,064**
CURRENT LIABILITIES		
Trade and other payables	96,927	116,888
TOTAL CURRENT LIABILITIES	**96,927**	**116,888**
TOTAL LIABILITIES	**96,927**	**116,888**
NET ASSETS	**410,703**	**477,176**
EQUITY		
Retained surplus	410,703	477,176
TOTAL EQUITY	**410,703**	**477,176**

STATEMENT OF CASH FLOWS FOR THE YEAR ENDED 30 JUNE 2020

	2020 $	2019 $
CASH FLOWS FROM OPERATING ACTIVITIES		
Receipts from members	73,084	86,932
Conference income	135,146	52,673
Other income	17,143	17,808
Payments to suppliers and employees	(305,031)	(135,024)
Interest received	10,090	11,161
Net cash provided by/(used in) operating activities	**(69,568)**	**33,550**
CASH FLOWS FROM INVESTING ACTIVITIES		
Net increase/(decrease) in cash held	(69,568)	33,550
Cash at the beginning of the financial year	506,183	472,633
Cash at the end of the financial year	**436,615**	**506,183**

REVENUE

	2020 $	2019 $
Operating activities		
Administration Fund		
Subscriptions – ordinary, student, retired and Sustaining Members	81,217	83,268
Conference income – ComBio2018 *(see note)*	-	60,645
Conference income – ASBMB2019 *(see note)*	122,860	-
Advertising and insert in proceedings and magazines	4,280	3,740
Other Income	11,100	11,990
	219,457	**159,643**
Non-operating activities		
Interest received – Administration Fund	8,683	10,971
Donations	225	505
	8,908	**11,476**
Total Revenue	**228,365**	**171,119**

EXPENSES

	2020 $	2019 $
Other expenses from ordinary activities		
Affiliate memberships	12,497	15,697
Awards and medals	18,500	16,900
Conference expenses – ComBio *(see note)*	174,875	-
Conference support – other conferences	3,398	8,198
Council expenses	4,009	5,699
Insurance	1,138	1,176
National Office costs	40,501	40,137
Magazine costs	9,179	10,281
Other costs	4,179	4,326
State allocations	8,949	8,000
Remuneration of auditor		
- audit or review services	2,828	2,850
- other services	2,285	2,400
ASBMB Fellowship – Research Fund	12,500	10,000
	294,838	**125,664**

CASH AND CASH EQUIVALENTS

	2020 $	2019 $
Cash at bank – Administration Fund	436,615	506,183
	436,615	**506,183**

TRADE AND OTHER PAYABLES

	2020 $	2019 $
Current		
Accrued expenses – Administration Fund	809	2,216
ComBio/ASBMB conference receivables	34,220	45,480
GST Receivable	-	412
Advances to state committees	35,700	35,700
	70,729	**83,808**

RETAINED SURPLUS

	2020 $	2019 $
Administration Fund		
Retained surplus at beginning of the year	(66,473)	431,721
Net surplus (deficit) attributable to the Fund	(66,473)	45,455
Retained surplus at the end of the year	(66,473)	**477,176**

All sums given in Australian Dollars.

Note: Conference Income and Conference Revenue

ComBio2018 was supported by a number of likeminded societies. The Association's share of revenue from that conference was $319,342 and its share of the expenses was $258,697, giving a profit share of $60,645.

The ASBMB 2019 conference was solely supported by the Association, with revenue of $122,860 and expenses of $174,875, resulting in a net loss of $52,015.

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If you answered yes to any of the above, SDR Scientific would love to help you!

SDR Scientific has just been appointed by FIALab Instruments (US) to deliver a water technology and testing system here in Australia and NZ. The equipment is designed to test water and soil for a number of important components such as nitrate, phosphate, sulphate, ammonia and many others. This system has some exciting points of difference.

Would this be of interest to you or to someone else within your workplace?

Discover more by reaching out to your friendly SDR Scientific Technical Sales and Support Specialist on 02 9882 2882 / +61 2 9882 2882 or by clicking here.

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We also pride ourselves on being there to support our customers with knowledge and expertise. The Cytiva applications support team handle scientific questions regarding a wide variety of applications and techniques, from supporting the discovery of new applications to optimising protocols – as well as troubleshooting your experiments.

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Liquid handling is a core process in practically every life science laboratory and a core focus of Eppendorf. In 1961, Eppendorf launched the first piston-stroke pipette, therefore 2021 marks the 60th anniversary of this technology. Today, Eppendorf's broad product offerings in liquid handling range from manual and electronic pipettes, dispensers, burettes and the EpMotion automated pipetting systems. Eppendorf products are associated with state-of-the-art technology, outstanding ergonomics, and award-winning design. A full suite of liquid handling services, including NATA accredited pipette calibration, is also available.

Most recently, Eppendorf has redefined adjustable tip spacing pipettes with the launch of the 'Move It®' range. This is in response to researcher requests for an efficient and safe solution for synchronous pipetting of multiple samples between different vessel formats, such as between tubes and plates. What is unique about the new 'Move It'? It can do this without any tubing connections between the cone and the piston-cylinder system. This enhances pipetting performance and having fewer movable parts, that are often fragile, means more precision and durability. 'Move It' is autoclavable to increase user and sample safety.

Visit www.eppendorf.com.au to see our full range of products and services.

Our Sustaining Members

BioNovus • LIFE SCIENCES •

Recombinant SARS-CoV-2 Spike Mutants

Since emerging in 2019, SARS-CoV-2's genome has proved to be relatively stable. However, the emergence of multiple new variants in late 2020 has caused concern over the efficacy of recently developed countermeasures, including diagnostics, therapeutics and vaccines. Many mutations have occurred in the spike protein and its receptor-binding domain (RBD), which plays a central role in pathogenesis and the induction of neutralising antibodies.

To support the investigation of SARS-CoV-2 variants, The Native Antigen Company offers a growing range of recombinant mutant spike antigens. Expressed using their proprietary mammalian expression system, these antigens display full glycosylation and proper folding for use in the development of high-performance assays and other applications.

Recombinant mutant antigens are available for the following SARS-CoV-2 lineages (spike mutations):

- European variant, B1 (D614G)
- Scotland-1 (D614G, L84I, N439K)
- England-1 (D614G, S477N)
- England/Bristol-1 (D614G, V445I, H655Y, E583D)
- Australia-1 (D614G, G485R)
- Sweden-1 (D614G, E484K)
- European Variant, B1 (D614G)

Due for release early in 2021 are a range of recombinant antigens of the spike mutations of the following SARS-CoV-2 lineages:

- UK Variant, B.1.1.7
- Brazilian Variant, B1.1.24
- B1.1.298
- B1.1
- B.1.258, B.1.141 / B1.258
- Spanish Variant, B1.177
- South African Variant, B.1.351 (501Y.V2)

BioNovus Life Sciences
David Antonjuk
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DAINTREE scientific AUSTRALIA

Daintree Scientific Australia presents QSonica's Q2000 package for Cannabis extracts. Cannabis extracts must be properly emulsified in order to be infused into edibles, beverages, tinctures and creams. Sonication is a well-established emulsification technique that breaks down the oils into nanoparticles resulting in a stable emulsion.

The Q2000 offers the ability to process large volumes in individual batches or flow through applications. This model includes a high amplitude (100um), 1.5" diameter, 10" long probe and booster. The Q2000 with standard probe is recommended for 5–10L samples. Two additional probe sizes are available to accommodate smaller volumes. This enables the Q2000 system to be used for small R&D batches and can be scaled up to production volumes.

The Q2000 Sonicator allows the user to program processing times and a full range of intensity settings. Processing times can be set from 1 second to 10 hours. A pulsing feature is standard. Pulsing can reduce the amount of heat generated by sonication when processing temperature sensitive samples. A temperature monitoring probe is also available.

All sonicators supplied by Daintree Scientific Australia include a 2-year warranty on both parts and labour.

Contact Daintree Scientific Australia to discuss the QSonica range of sonicators, stocked in Australia for fast delivery.

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Reveal Complex Individual Cell Behaviours and Unlock Unique Insights in Every Assay

Livecyte – not another Microscope!

Individual cell segmentation and tracking using traditional label-free methods such as brightfield or phase contrast is challenging due to lack of inherent imaging contrast. Fluorescent labels enhance cell contrast but the high intensity light required to excite fluorophores can alter cell behaviour and induce cell death largely due to photodamage.

So, how do we do this better?

Ideally, live cell imaging needs to identify and track individual cells for prolonged periods without the need for perturbing labels and provide high contrast images under low levels of light intensity, to preserve natural behaviours and allow recovery of cells for subsequent experimentation or downstream analysis. A continuous, large field of view with no loss of resolution or focus that permits even highly motile cells to be tracked during time-lapse imaging can prevent potentially important cells from being lost or overlooked. Information rich reliable data is key where each experiment automatically yields a plethora of phenotypic parameters such as cell thickness, volume, dry mass in addition to kinetic behaviour characterised by cell speed, displacement and confinement ratio.

Phasefocus Livecyte delivers all of this and more!

Livecyte uses ptychography, an emerging imaging technique, that can provide you with data not available with any other instrument. High-contrast, fluorescent-like images are generated using low powered illumination (4–7μW/mm^2), in which cells appear as bright objects on a dark background. Livecyte can extract the changes in morphology, motion and dry mass of each cell over time. This leads to a more complete characterisation of cell phenotypic properties. Tracking and analysis of individual cells, along with population metrics, to monitor cell speed and directionality of migration together with cell proliferation can allow greater insights into biological processes. Livecyte offers the versatility to measure and monitor sensitive cell types such as primary cells, patient derived cells and stem cells. Livecyte can also perform correlative fluorescence and brightfield imaging.

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Tip ejection is almost effortless, via the corrosion-resistant ejector with unique shock-absorbing mechanism. The tip cone is highly durable PVDF and large 4-digit display has a lock setting. There are 9 variable-volumes models, 14 fixed volumes and 12 multi-channel models available. All are calibrated in an ISO-accredited lab and in-house recalibration is easy.

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Joko Logis is the most recent addition to the BMG LABTECH APAC Specialist Team, providing online and remote support for all BMG LABTECH customers in the APAC region. Our customers can access our scientifically trained specialists from just a phone call, email or mouse-click. By using a range of remote solutions that best suit our customers' needs, Joko and our team can continue to get to the heart of every request as quickly and efficiently as possible.

BMG LABTECH's mission is to become the first-choice supplier for microplate reading technology, providing the highest quality and technical excellence, backed by outstanding service and support. To chat to our team about how we can support your laboratory, get in touch by emailing australia@bmglabtech.com.au or click REMOTE SUPPORT to access our Technical Support Specialists.

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The basic 200 imager is for streamlined gel documentation and densitometry (white light, blue light, and UV). Upgrade to the 300 to add the ability to detect chemiluminescence at the same sensitivity as film. The 300 can upgrade to the 400, which adds visible (RGB) fluorescence detection, or the 500 for infrared laser excitation for quantitative Western Blot imaging in the NIR.

All of these models can be upgraded to the 600 which combines all of these detection modes – white light, blue light, UV, chemiluminescence, visible fluorescence, and NIR fluorescence – in a single powerful instrument.

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High Performance DNA Kits to Advance Microbiome Research

MP Biomedicals has recently introduced two new high-performance DNA extraction kits suitable for microbiome studies in soil and in faeces samples.

We understand the complex nature of microbiome specimens which can hinder scientists from getting sufficient yield and purity of DNA. With that in mind, two new improved kits are now available (1) **SPINeasy™ DNA Kit for Soil** and (2) **MagBeads FastDNA™ Kit for Feces**.

SPINeasy™ DNA Kit for Soil (SKU 116530050) employs spin column technology with proprietary buffers to protect the DNA from degradation. Highlights of the kit includes quick isolation of gDNA from soil in less than 30 minutes and specially formulated buffers to remove humic substances and other inhibitors.

MagBeads FastDNA™ Kit for Feces (SKU 116570400) allows high yield and quick isolation of gDNA from faecal samples. It is using magnetic beads technology with high binding capacity to gDNA. When tested on human and various animal faecal samples, the kit has shown outstanding yield and purity of gDNA. Procedure turnover time is less than 60 mins and this kit can be adapted for high throughput processing using automated nucleic acid extraction instruments.

Samples available at SpinEasy-Magbeads mpbio.com

Analytik Jena ScanDrop² Nano-volume Spectrophotometer

Introducing the Analytik Jena ScanDrop², a UV/Vis spectrophotometer specially designed for the analysis of microliter samples from 0.3µL–2mL. With a selectable range between 190–1000nm in 0.5 nm increments, the unit can record a complete spectrum between 1.6–12.8s depending on the sample adaptor used.

Unique to the ScanDrop² is the patented ChipCuvette, to measure sample volumes from 0.3µL to 4µL. The adaptor cell contains 16 micro channels, each with two independent pathlengths (0.1mm and 1.0mm). Using both, the software calculates the optimal pathlength to record the sample concentration, foregoing sample dilution, saving time and resources.

Operators can use an onboard 10.1" tablet for a stand-alone system or alternatively control with an external computer running the FlashSoftPro² software.

Features:

- Three unique adaptors:
  - ChipCuvette: < 16 sample measurements (0.3µL–4µL)
  - Butterfly Cuvette: < 9 sample measurements (2µL–4µL)
  - 8-cell cuvette changer
- Powered by Xenon Flash Lamp
- Wavelength selection 0.5nm increments from 190nm to 1000nm
- Control via PC or optional 10.1" tablet
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This reader takes a user friendly approach to the most common cytometry applications:

- Confluence
- Nucleic counting
- Transfection efficiency
- Cell viability
- Cell death

For example, for cell death, the detection of, and discrimination between, apoptosis and necrosis can be accomplished by differential staining of markers characteristic of the relevant type of cell death. This can be done using Hoechst 33342, propidium iodide and Annexin V-FITC.

Hoechst 33342 (blue) – nuclei stain

Propidium iodide (red) – necrotic cell stain

Annexin V-FITC / Alexa Fluor® 488 (green) – binds to the early apoptosis marker phosphatidylserine

Using a proprietary algorithm, the software can uniquely identify three object classes:

- Blue objects – cell nuclei
- Blue/red objects – necrotic cells (for live:dead cell ratio)
- Blue/red/green objects – apoptotic cells (for apoptotic:necrotic cell ratio)

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The new 6800-18 Aquatic Chamber extends those capabilities to aquatic samples, enabling measurements of CO_2 exchange and chlorophyll α fluorescence from 15 mL samples of algae in suspension.

A differential CO_2 measurement

The carbon assimilation rate is determined from the mass balance of an air stream before and after it interacts with a liquid sample. The instrument maintains equilibrium between the aquatic sample and headspace air using a controlled aeration scheme.

A steady-state sample environment

Sample conditions are held at a steady state during a measurement. Temperature, light, and pCO_2 are all controlled parameters, enabling hypotheses that test a single variable while others are stable.

Chlorophyll a fluorescence and a controlled light environment

The fluorometer measures chlorophyll α fluorescence from the sample with a PAM fluorometer. It also provides independent control of blue, red, and far-red light in the chamber.

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AXT

End-to-End Genome Sequencing Sample Preparation

The race to control the COVID-19 pandemic has highlighted the need to understand the virus better. Whole-genome sequencing of the virus provides critical data that helps health agencies manage COVID-19 outbreaks in specific countries/regions. Such data helps accelerate vaccine research efforts and decrease the price point. This highlights the importance of automation and miniaturization.

The use of SPT Labtech's dragonfly® discovery for cDNA synthesis and PCR master mix additions steps provides significant time saving and reduction in reagent dead volume; not to mention hugely reduced tip consumption compared to using tradition pipette tip based liquid handling. The system also enables miniaturization (384 well plate method) due to low volume accuracy and precision.

Working hand-in-hand with the dragonfly® discovery, SPT Labtech's mosquito® HV genomic is optimised for use in low volume (384) workflow for high speed, low volume sample transfers. Together with SPEX SamplePrep's Geno/Grinder tissue-lyser and Cole Parmer's PCRmax Eco 48 system, AXT has your whole-genome sequencing needs covered.

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The demand for safer biologicals and biopharmaceuticals has led Worthington to introduce several *Animal Free (AF)* enzymes for primary/stem cell isolation, tissue culture research and vaccine bioprocessing. Scientists working in regenerative medicine applications including the isolation of stem cells, tissue transplantation, artificial organ development and vaccine production would benefit from AF enzymes since there is no risk of potential BSE/TSE and/or mammalian viruses contaminants. In addition, the use of AF enzymes eliminates many of the quality and regulatory issues and concerns associated with enzymes purified from animal sources.

The lot-to-lot variation which is typical of enzyme preparations makes it important to pre-test a particular lot of enzyme you are planning to use in your experiment. Many years ago we found that the most practical approach for the researcher is to pre-sample several different lots of collagenase at a time and select the best of the group. As the world's leading manufacturer of collagenase, Worthington is able to offer the greatest number of different lots at any given time and recommend specific lots for an application. Regular grades of Worthington *Animal Free* collagenase are also available for sampling.

There is no charge for participating in the collagenase sampling program. Under the program, individual researchers are provided with 100 mg samples of up to three different lots of collagenase for evaluation in their own assay systems. A period of 60 days is allowed for your evaluation of these samples. A minimum of 3 grams of each lot will be placed on HOLD, reserved in your name. When you determine which lot performs best for you, simply specify the lot desired when ordering.

To become part of this program, or to discuss any of the Worthington products, just call **ScimaR** at 1800 639 634, email scimar@bigpond.net.au or visit our website www.scimar.com.au

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'Campus Visit' Result

The winner of the December competition is the von Itzstein group, Institute for Glycomics, Griffith University. Congratulations to group, which will receive a gift voucher.

***Solution** **1** Australian National University, **2** University of Melbourne Bio21 Institute, **3** University of Sydney, **4** Monash University, **5** La Trobe University, **6** University of Adelaide, **7** The Australian Synchrotron, **8** University of Tasmania, **9** University of Queensland, **10** Walter and Eliza Hall Institute, **11** University of Western Australia, **12** CSIRO (Black Mountain, Canberra)*

ASBMB Council 2021

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