3Rs and biophysics

Cris dos Remedios¹ · Michelle Peckham²

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The basis for the 3Rs and Biophysics session is simple: We assume that no biophysicist would deliberately and unnecessarily kill an animal in the name of research. The 3Rs in the session title refer to Replacement, Reduction and Refinement of the use of animals in research. In different ways, the four speakers in this session address the 3Rs theme. While this session deals with all three aspects of the 3Rs, it places a strong emphasis on replacing animals in research.

The first two speakers will focus on totally synthetic antibody-mimetic molecules (Affimers). These are antibody-like molecules but are much smaller (~100 amino acids, 10 kDa MW) (Tiede et al. 2017). Their small size provides huge advantages for researchers. Affimers comprise protein scaffolds that constrain regions of variable peptides to serve as molecular recognition motifs. Dr. Christian Tiede and his colleagues have generated a very large phage display library, up 2.3×10^{10} , based on these Affimers. He will discuss the use of Affimers to bioscreen for chemicals, peptides, target proteins, and even complex cells and biofluids. He is currently screening highly-specific Affimers directed against over 500 targets.

Dr. Michelle Peckham discusses the use of Alexa-647-labelled Affimers as antibody-mimetic probes (Kd 300 nm) for F-actin using both fixed and live cells. The red fluorescence means that troublesome autofluorescence is essentially avoided, and opens the way to using ‘super-resolution’ microscopy.

Cancer and heart failure are the two biggest killers of human patients. In 2010, Dr. Valerie Spears developed the Breast Cancer Now Tissue Bank (BCNTB) (Helen et al. 2017). This carefully-annotated source of human breast cancer tissue was established to meet the needs of the breast cancer research community (Spears and Roberts 2017). The BCNTB contains ethically-collected breast cancer tissue from patients and provides it to researchers with high-quality, relevant bio-banked fresh frozen tumour and surrounding tissue, whole blood and serum samples, as well as formalin-fixed paraffin-embedded tissue. This is helping to raise the standard of breast cancer research and to facilitate the co-ordinated translation of scientific findings into the clinical setting.

Dr. dos Remedios takes a similar approach. He started the Sydney Heart Bank (SHB) in 1989 and has developed the largest single resource (>16,000 tissue samples) for research into the causes of human heart failure (Lal et al. 2015). Like cancer, heart failure is not a single molecular or even single cellular defect. The SHB tissues were harvested from ~450 heart transplant patients and over 120 non-failing donor hearts. It has, together with over 50 research laboratories, produced over 100 research papers and contributed substantially to the current body of knowledge of heart failure. The success of the SHB is due to the complete absence of post-mortem cellular and molecular degradation of the heart samples by cryopreserving them within minutes of the loss of coronary artery blood flow. As a result, the SHB tissue has created an International heart failure consortium by providing tissue to hundreds of researchers to test their ideas on subjects as broad as the Frank–Starling hypothesis down to the details of which serines are phosphorylated cardiac troponin I.

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✉ Cris dos Remedios
crisdos@anatomy.usyd.edu.au

¹ University of Sydney, Sydney 2006, Australia

² School of Molecular and Cellular Biology, University of Leeds, Leeds, UK

Both the Speirs laboratory and the SHB (Lal et al. 2016) have made significant advances without the use of animal-based models.

Arguably, the best reason for producing this symposium is to get the next generation of young biophysicists thinking about how to replace the use of animals in their future research. Medical Advances Without Animals (MAWA) is an Australian not-for-profit organization, like the UK Animal Free Research organization. The 3Rs and Biophysics session will award certificates of achievement to the finalists, and the best 3-min oral presentation will receive £350 provided by MAWA.

Compliance with ethical standards

Conflict of interest Dr. dos Remedios serves on the Board of Medical Advances Without Animals who contributed funding for the 3Rs and Biophysics session. Cristobal G. dos Remedios declares that he has no conflicts of interest. Michelle Peckham declares that she has no conflicts of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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