

From sheep fertility and IVF to growing complex organs: Melbourne's stem cell story

Stem cell scientists gather in the city of landmark discoveries

The International Society for Stem Cell Research 2018 Annual Meeting brings the field's scientists to a country and city with a rich stem cell research heritage.

Bone marrow transplants to treat blood cancers and other blood disorders were the first stem cell treatments. In the 1960s, **Don Metcalf** at the **Walter and Eliza Hall Institute** in Melbourne discovered colony stimulating factors, the molecules that stimulate stem cells to multiply and mature, which revolutionised bone marrow transplants and the treatment of blood diseases.

Opera singer **Jose Carreras**, one of the millions of people who have had this stem cell treatment for leukaemia, credits his survival to Don Metcalf.

Around this time, wool was one of Australia's top exports, but Australian merino sheep were having fewer lambs than their overseas counterparts. Sheep fertility and animal reproduction research received a massive funding boost in the 1960s and 1970s.

Melbourne obstetrics professor **Carl Wood** was working to address infertility in women when he heard about **Alan Trounson's** animal fertility achievements, developing techniques to stimulate ewes to produce multiple eggs, which were harvested, fertilised in a culture dish and implanted back into the sheep uterus. Their pioneering work in IVF technology led to the world's third IVF baby in 1980, and the first donor egg and frozen embryo pregnancies. This helped solidify Melbourne's position on the global medical map.

Local interest in embryonic stem cells grew, drawing on this expertise. **Martin Pera's** research group at **Monash University** became the world's second research team to isolate human embryonic stem cells. This group was also the first to describe how stem cells specialise (or differentiate) into the different types of cells that make up the body.

Martin Pera and Alan Trounson went on to discover that nerve stem cells can be derived from embryonic stem cells.

Melbourne has seen several other 'firsts' in stem cell science.

Perry Bartlett, then at the Walter and Eliza Hall Institute, was the first to discover stem cells in the adult brain, overturning the dogma that the mature brain is fixed and unable to repair and regenerate. He went on (and moved northwards) to found the Queensland Brain Institute.

Jane Visvader and **Geoffrey Lindeman** led the team that first identified and isolated breast stem cells, and later breast cancer stem cells. This opened up a new field of research in breast cancer—breast stem cell biology.

More recently, **Melissa Little** has led pioneering work at the **Murdoch Children's Research Institute** growing the first 'mini-kidney' organoids from stem cells derived from adult skin cells. Her methods coax the stem cells to ultimately become 12 different types of kidney cell, self-organising into functional kidney tissue.

Melbourne is home to the **Australian Regenerative Medicine Institute**, a \$153 million joint venture of the Victorian Government and Monash University, which conducts fundamental research into stem cell science and is developing treatments for a range of diseases, such as cancer, diabetes, cardiovascular diseases, arthritis and other musculoskeletal conditions. And it hosts AquaCore, the largest zebrafish and axolotl facility of its kind in the Southern Hemisphere.

Melbourne is the nerve centre for **Stemformatics**, an online resource that the global stem cell research community is using to rapidly share knowledge and fast track stem cell discoveries. Led by **Christine Wells** at

The **University of Melbourne**'s new Centre for Stem Cell Systems, this initiative maps and makes available detailed information about how different genes are expressed as stem cells divide and specialise.

And the leadership is continuing: a team at **The Florey Institute of Neuroscience and Mental Health** is in the race to bring a stem cell treatment for Parkinson's disease to human trials; the **Centre for Eye Research Australia** is pioneering robotic cell culture technologies; and Melbourne-based multinational companies, such as **Mesoblast** and **CSL**, are investing in local biomedical manufacturing. Mesoblast is poised to commercialise the first industrially manufactured stem cell therapy in the USA.

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