2014 Stories of Australian Science

Inside: science heroes, inventions, discoveries and ideas

Our thanks to the following organisations for their financial support:

Advanced Instrumentation and Technology Centre at ANU

Australian Institute of Marine Science

Australian Regenerative Medicine Institute, Monash University

CSIRO

CSL Limited

Australian Government's Department of Industry

EMBL Australia

Inspiring Australia

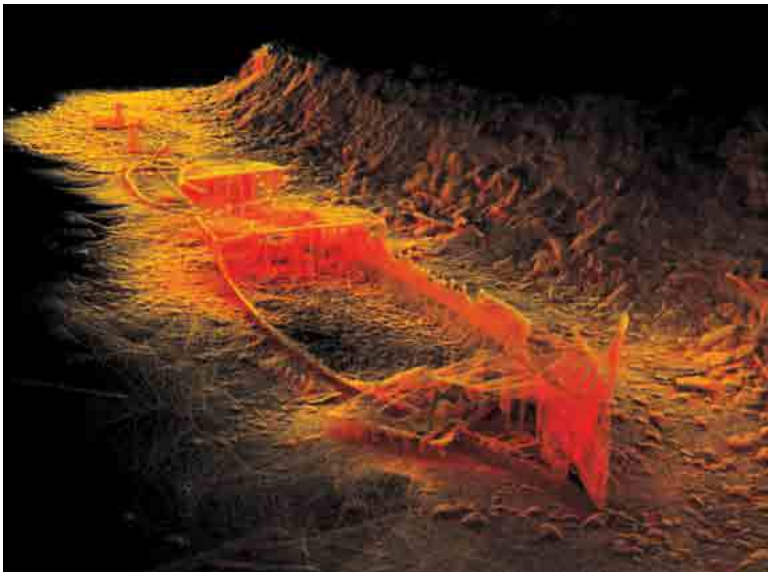
L'Oréal Australia

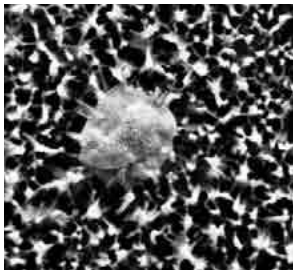
National Centre for Groundwater Research and Training, Flinders University

Robinson Research Institute, University of Adelaide

Swinburne University of Technology

Victorian Life Sciences Computation Initiative





Welcome to Stories of Australian Science 2014

Australian ideas are transforming lives around the world: the bionic ear, cervical cancer vaccines, gum that repairs teeth, the astronomical ideas that make Wi-Fi fast and reliable and many more.

In this collection of stories you'll hear about the next generation of ideas and discoveries that will change the world: from big ecology to quantum computing; from vast water reserves to tracking typhoid; from growing new limbs to watching serial killer cells.

We've included winners of many of Australia's science prizes: people whose discoveries and inventions are transforming mining, medicine, maths and more.

And we've included the best young researchers from Fresh Science. Watch these young achievers in coming years.

Science is a driver of economic, social and cultural change.

It tells us how our world is changing, and what we can do about it, if we choose to.

But science needs stories and it needs heroes to tell those stories in order to engage with the wider community.

We believe this collection of stories helps. It's a taste of the best of Australian science.

All the stories are online at www.scienceinpublic.com.au/stories.

Please feel free to share the stories with your own audiences. Everything is cleared for reproduction and you can search through hundreds of yarns from our past collections.

Enjoy this dose of science!

Sarah Brooker
Managing Director

Niall Byrne
Creative Director

Science in Public @scienceinpublic

Stories of Australian Science 2014...Stories of Australian Science 2014...Stories of Australian Science 2014...Stories of Australian Science 2014...Stories of Australian Scie

SCIENCE IN PUBLIC

Science in Public is based in Melbourne, Australia.
We help scientists present their work in public space.

Science in Public Pty Ltd
82 Hudsons Road
(PO Box 2076)
Spotswood Victoria 3015 Australia

Tel: +61 (3) 9398 1416
niall@scienceinpublic.com.au
www.scienceinpublic.com.au

Concept/editor in chief
Niall Byrne

Project coordination
Margie Beilharz

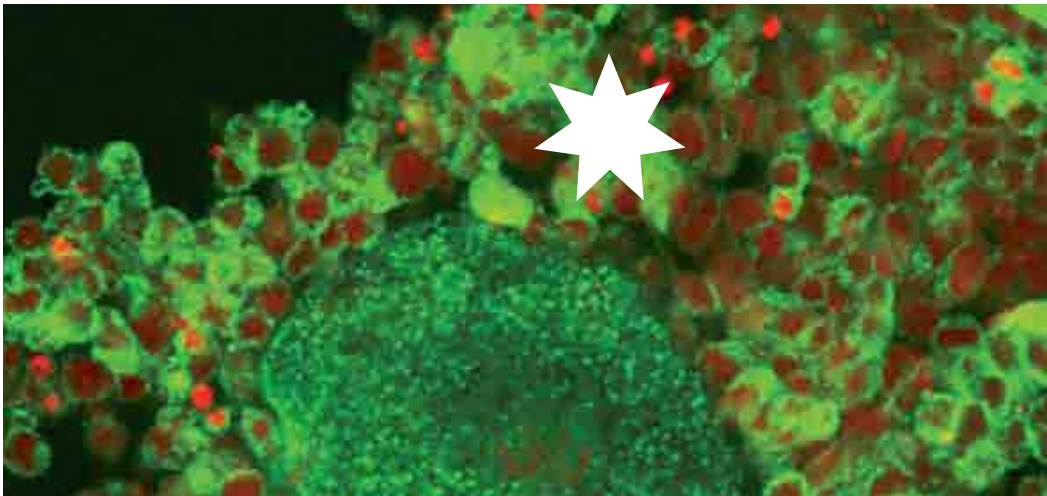
Editing and writing
Chris Lassig
Jane Lyons
Melissa Trudinger
Margie Beilharz
Tim Thwaites
Samantha Harris-Wetherbee
Laura Boland

Design
www.saltcreative.com.au

Print
immij

PHOTOS: FRONT COVER: LEFT: ANGELA CREAN'S RESEARCH ON SEA SQUIRTS MAY ASSIST IVF METHODS, CREDIT: UNSW, SEE P 20; RIGHT: (TOP) BARLEY IS VULNERABLE TO LEAF RUST, CREDIT: LEE HICKEY, SEE P 21; (BOTTOM) VACCINATING AGAINST ROTAVIRUS IN YEMEN. THE VIRUS WAS FIRST DESCRIBED IN MELBOURNE BY RUTH BISHOP, CREDIT: AMIRA AL-SHARIF/GAVI/2012, SEE P 11. OPPOSITE PAGE: TOP: RESISTANT STARCH IN THE DIET MAY PROTECT MILLIONS OF CHILDREN IN DEVELOPING COUNTRIES FROM DIARRHOEA, SEE PAGE 18; BOTTOM: AUSTRALIA'S ANZAC FRIGATES ARE BEING UPGRADED WITH IAN CROSER'S RADAR TECHNOLOGY TO DEFEND THEMSELVES AGAINST MISSILES, CREDIT: AUSTRALIAN DEFENCE DEPARTMENT THIS PAGE: LEFT: A 3D LASER SCAN BY ZEBEDEE OF THE WRECK OF THE HMQS *GAYUNDAH*, AT REDCLIFFE, QUEENSLAND, CREDIT: CSIRO, SEE PAGE 16; MIDDLE: (TOP) ARTIST'S IMPRESSION OF A STAR BEING PULLED INTO A BLACK HOLE, CREDIT: GABRIEL PEREZ DIAZ, SEE P 7; (BOTTOM) SCANNING ELECTRON MICROSCOPE IMAGE OF DISRUPTED *STAPHYLOCOCCUS AUREUS* CELLS ON A DRAGONFLY WING, CREDIT: SWINBURNE UNIVERSITY OF TECHNOLOGY, SEE PAGE 13; RIGHT: LAND CLEARING AND ACIDIFICATION THREATEN THE GREAT BARRIER REEF, SEE PAGE 12.

Turning a nation on to science



Prime Minister's Prizes for Science

Since 2000 Australia's Prime Ministers have recognised the best in science. In 2013 our new Prime Minister Tony Abbott honoured three scientists and two teachers including:

- a man of numbers whose statistical skills have contributed to farming, diamonds, justice (and the OJ Simpson trial), and now to slashing cancer surgery rates
- a young woman who is overturning 'zombie science' in ecology by crunching large botanical data sets harvested online and from visits to some 50 global ecosystems
- the likely creator of the world's first quantum computer using silicon. He and his colleagues have already created the critical building blocks—reading and writing the spin state of a single electron.

www.industry.gov.au/scienceprizes

THE PRIME MINISTER'S PRIZES FOR SCIENCE

Terry Speed: Fighting cancer by the numbers

Terry Speed doesn't expect to see headlines reading "Statistician cures cancer" any time soon. But he knows that maths and stats can help researchers understand the underlying causes of cancer and reduce the need for surgery.

A mathematician and statistician, he has written elegant theoretical papers that almost no-one reads. But he has also testified in court, helped farmers and diamond miners, and given biologists statistical tools to help them cope with the genetic revolution.

For his contribution to generating knowledge using genomics and related technologies, Terry, head of Bioinformatics at the Walter and Eliza Hall Institute of Medical Research (WEHI), was awarded the 2013 Prime Minister's Prize for Science.

At the University of California, Berkeley, in the '80s and '90s, Terry came across the new microarray technology that simultaneously assessed the activity levels of thousands of genes. There he developed statistical analysis techniques that are still widely used.

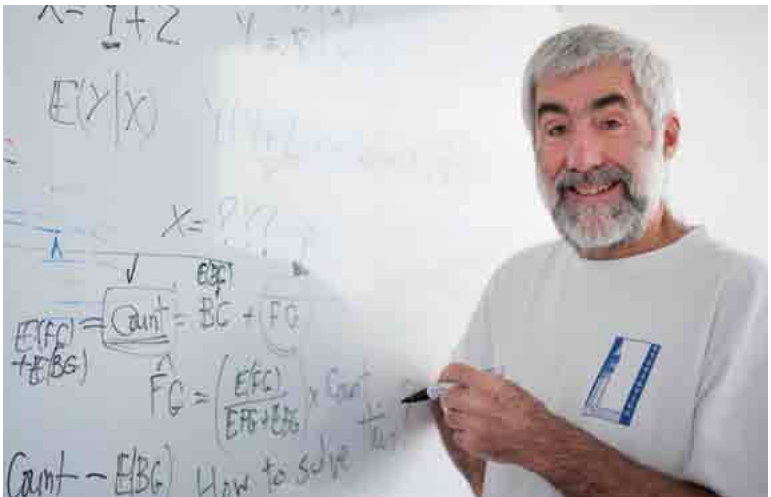
Now at WEHI, Terry applies statistics to the fields of genetics and molecular biology. Cancer is a particular focus. He is developing techniques to sort out the thousands of differences between normal and cancer cells, investigating ideas to treat cancer more efficiently, and working with the small company Veracyte to create a tool to determine whether your thyroid growth is benign.

Angela Moles: Rocking the ecological boat

Until recently, everyone thought that the biologically active candidates for new drugs would mainly be found in high-biodiversity tropical forests.

"No," says plant ecologist Angela Moles. "Up in the Arctic tundra are 100-year-old willow trees just a few centimetres tall. They grow just a few leaves each year and can't afford to lose them. So, as you get closer to the poles, the chemical warfare intensifies."

She studies thousands of species at once—by scouring the world's computer databases and undertaking extensive field trips across jungles, deserts and tundra, assisted by a global army of collaborators—and hopes to help predict the impact of climate change, so that we cope better with its effects.



Angela has used data on 450,000 species from 40,000 different sites for the first serious analysis of how plant height varies with latitude, again with surprising results. Typically plant heights decrease with distance from the equator, but Angela found a sudden drop in height at the edges of the tropics, suggesting a complete change in growth strategy.

For her work in establishing Big Ecology—the study of ecology at a global level—Angela was awarded the 2013 Frank Fenner Prize for Life Scientist of the Year.

Andrea Morello: Quantum computing becomes more than just spin

People have speculated about the potential of quantum computers for decades—how they would make child's play of constructing and testing new drugs, searching through huge amounts of data and ensuring security of information.

This scenario may be coming true in a high-tech basement at the University of New South Wales.

Andrea Morello and his colleagues at the ARC Centre of Excellence for Quantum Computation and Communication Technology are developing the building blocks of a quantum computer, and they expect to build a working prototype within a few years. What's more, it will be constructed out of the same inexpensive, abundant material used to build classical computers—silicon. Their studies place Australia in the lead in the race to construct one of the game-changing technologies of this century.

For his intellectual leadership in developing the silicon components to make quantum computing possible, Andrea was awarded the 2013 Malcolm McIntosh Prize for Physical Scientist of the Year.

Assisted by colleague Andrew Dzurak and others, Andrea has shown how to read information from and write information to the spin of a single electron, and now to an even more reliable single phosphorus nucleus.

Motor races and science labs fuel interest in science

Each year in early July, when its 700 students are on holiday, Townsville State High School becomes the headquarters for a V8 Supercars race.

But before and after the race, Sarah Chapman's Year 11 science students are hard at work, slopping their way through the nearby mangroves and wading into the neighbouring estuary. The data they collect is then used by the Great Barrier Reef Marine Park Authority to manage the impact of the race on local estuaries. "The students are really taken by the idea that they are finding out things nobody else knows," Sarah says.

Sarah relates her science teaching to daily life, and to her audience, such as by investigating the elasticity of jelly snakes and the thermochemistry of chewing gum.

Richard (Ric) Johnson has reinvented the primary school science lab, complete with overhead pterosaurs and a solar BBQ at Rostrata Primary School in Perth. "It worked from the very beginning," Ric says. "Some of the boys became so excited they had to go to the toilet halfway through class. And it's just got better and better."

The idea has snowballed and Ric now knows of at least 40 similar labs in Western Australia. And his accompanying website, Johnno's Science (www.johnnosscience.com), is inspiring thousands of teachers around the world.

For their innovations in and contributions to teaching science, Sarah and Ric have each received a 2013 Prime Minister's Prize for Excellence in Science Teaching.

A new job for glass fibres

While researching the performance of the optical fibres that are the backbone of telecommunications and the internet, Tanya Monro realised that they could do much more.

She's invented a new class of hollow or holey fibres using soft glass, which have thousands of applications as sensors: detecting metal fatigue in aircraft wings and other structures; monitoring contamination in water supplies; and a smart bung that monitors wine development while it's still in the barrel.

Her latest venture is leadership of a new ARC Centre of Excellence for Nanoscale BioPhotonics, which will develop her fibres to watch developing embryos, probe immune signals, and explore plaque in our arteries.

Tanya won the Malcolm McIntosh Prize for Physical Scientist of the Year in 2008.

How bugs stick to our stomachs

James Whisstock and his Monash University colleagues have uncovered how the bacterium *Helicobacter pylori* sticks to the stomach lining, where it can cause ulcers and sometimes cancer.

The role of *Helicobacter* in causing gastric ulcers was originally discovered by Australian Nobel Laureates Barry Marshall and Robin Warren.

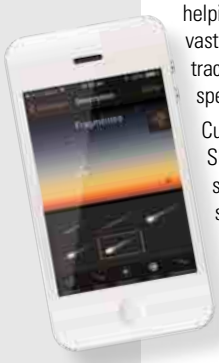
The recent work by James and his team was performed using the Australian Synchrotron and showed how the *Helicobacter pylori* protein SabA interacts with sugars present on the cells that line the stomach.

James received the Science Minister's Prize for Life Scientist of the Year in 2006 and has just been awarded a $28 million grant to build the ARC Centre of Excellence in Advanced Molecular Imaging, which will develop new approaches for understanding the workings of the immune system.

PHOTOS: PAGE 2: TOP: ARTIST'S IMPRESSION OF THE GIANT MAGELLAN TELESCOPE, WHICH IS USING AUSTRALIAN ADAPTIVE OPTICS TECHNOLOGY, CREDIT: GMTO CORPORATION, SEE P 6; BOTTOM: ANGELA MOLES HAS STUDIED ECOSYSTEMS FROM TUNDRA TO DESERTS; GLUCOSAMINE MAY AFFECT FERTILITY, CREDIT: ROBINSON RESEARCH INSTITUTE, SEE P 10. PAGE 3: (TOP) PRIME MINISTER TONY ABBOTT WITH THE WINNERS OF HIS SCIENCE PRIZES: L-R: ANGELA MOLES, ANDREA MORELLO, TONY ABBOTT, TERRY SPEED, PARLIAMENTARY SECRETARY BOB BALDWIN, SARAH CHAPMAN, RIC JOHNSON, CREDIT: PRIME MINISTER'S PRIZES FOR SCIENCE/BEARCAGE; BOTTOM: (LEFT) TERRY SPEED, CREDIT: WEHI; (RIGHT) ANGELA MOLES, CREDIT: UNSW/PETER MORRIS.

Inspiring Australia

Over the past three years Australia has established and advanced a unique national engagement model—working with governments at all levels, with science sector agencies and organisations, as well as industry.



The results include:

- a cohesive national strategy for science communication
- three leadership bodies across science and governments
- state and territory-based science communication networks
- strategic approaches to six areas of industry-focused and regionally based science engagement
- increased industry-government engagement
- a common framework of principles for science communication initiatives
- development of an evidence base for the assessment of science engagement activities in Australia
- projects across Australia developing and strengthening science-media relationships and skills
- increased youth, Indigenous, regional and remote Australian science engagement.

Through these achievements, the Inspiring Australia initiative is ensuring that a strong platform exists from which quality coordinated science engagement activity can take place. With the ongoing support of the science communication sector, we are building a future for Australia inspired by science.

Citizen science: eyes in the skies and on the seas

Australian citizen scientists are helping to catch shooting stars in the vast skies of outback Australia and to track the impact of climate change on species in our warming oceans.

Curtin University's Fireballs in the Sky project invites people to use a smartphone app to record and submit the time, location, trajectory and appearance of meteors they spot.

By triangulating these reports with observations from an array of cameras in remote Western and South Australia, scientists can try to determine where the meteorite may have come from and where it landed.

The participants get to experience the highs (and occasional lows) of scientific endeavour, as well as learning about planetary science.

"It's about giving the public access to something not normally accessible—the workings of a real, legitimate research project," says Gemma Mullaney, Geoscience Outreach Officer at Curtin University.

Meanwhile, marine biologists working on the Range Extension Database and Mapping project—or 'Redmap'—are tracking shifts in species distributions using photographs taken by divers and fishers. Redmap was inspired by a finding that 80 per cent of Tasmanian rock lobster fishers didn't consider climate change a problem, despite observing its effects on the marine environment.

"The public often don't get the science of climate change modelling," says Gretta Pecl, Redmap founder and senior research fellow at the Institute for Marine and Antarctic Studies at the University of Tasmania.

"But people understand the simple idea that fish that prefer warmer waters might move farther south if the oceans are warming."

The involvement of citizen scientists enables the project to cover a huge area, and helps identify and prioritise locations and species for future research. The two projects are amongst some 63 backed by Inspiring Australia.

National Science Week

National Science Week is one of the highlights of the program. From desert ecology in Alice Springs to slow food at a Tasmanian radio telescope, National Science Week gives Australians creative ways to celebrate and learn about science, technology, mathematics and engineering. With almost 1.6 million people taking part in over 1800 events, it is the country's biggest festival.

The 17th National Science Week will take place from 16 to 24 August 2014.

Read more at www.inspiringaustralia.net.au and www.scienceweek.net.au.

An Australian Government Initiative

Inspiring AUSTRALIA

PHOTOS: OPPOSITE PAGE: (TOP) RIC JOHNSON, CREDIT: PRIME MINISTER'S PRIZES FOR SCIENCE/BEARCAGE; SARAH CHAPMAN AND STUDENT, CREDIT: PRIME MINISTER'S PRIZES FOR SCIENCE/BEARCAGE; (BOTTOM) ANDREA MORELLO, CREDIT: UNSW/PETER MORRIS. THIS PAGE: KEVIN WILSON RECORDED A RED EMPEROR 300 KM FURTHER SOUTH THAN PREVIOUSLY RECORDED, CREDIT: KEVIN WILSON; LONG-EXPOSURE OF STAR TRAILS AND A METEOR FIREBALL, CREDIT: DESERT FIREBALL NETWORK; TANYA MONRO, CREDIT: JENNIE GROOM. INSET: FIREBALLS IN THE SKY APP, CREDIT: DESERT FIREBALL NETWORK.

No more twinkle, junk and stars, now we know just where you are

Technology that 'de-twinkles' stars is being used to pinpoint manmade space junk and avoid devastating collisions like those dramatised in the movie *Gravity*.

Australian company Electro Optic Systems, based on Mount Stromlo in Canberra, is using adaptive optics and pulsing lasers to locate detritus too small for conventional radar. Ultimately, the company hopes to use similar lasers to remove the debris from orbit.

Adaptive optics helps the pulsing lasers to cut through the Earth's atmospheric turbulence, which distorts and scatters light, by using a second orange-coloured laser to illuminate sodium atoms in the upper atmosphere.

This creates an artificial 'guide star', or a bright spot of known size and position, which can be used to track and compensate for the atmospheric distortions.

"Normally the beam spreads out to 10 or 20 metres in width, but with adaptive optics we can focus it to within a metre," says François Rigaut, head of the Adaptive Optics Group at the Australian National University that developed the technology.

These distortions are also what causes the twinkling of stars, so it's no surprise that the ANU technology will also be used in the world's biggest telescope, the Giant Magellan Telescope, to be constructed in Las Campanas, Chile.

Just as its namesake Ferdinand Magellan navigated by the stars 500 years ago, this new telescope will use four laser guide stars to constantly adjust its mirrors, making it more powerful than even the Hubble Space Telescope.

"It will be able to see planets orbiting other stars and even measure the makeup of their atmosphere," says François. "It's very exciting."

For more information:

Australian National University,
François Rigaut,
Tel: +61 2 6125 0210,
francois.rigaut@anu.edu.au
www.rsaa.anu.edu.au

Wombat puts electric rocket through its paces

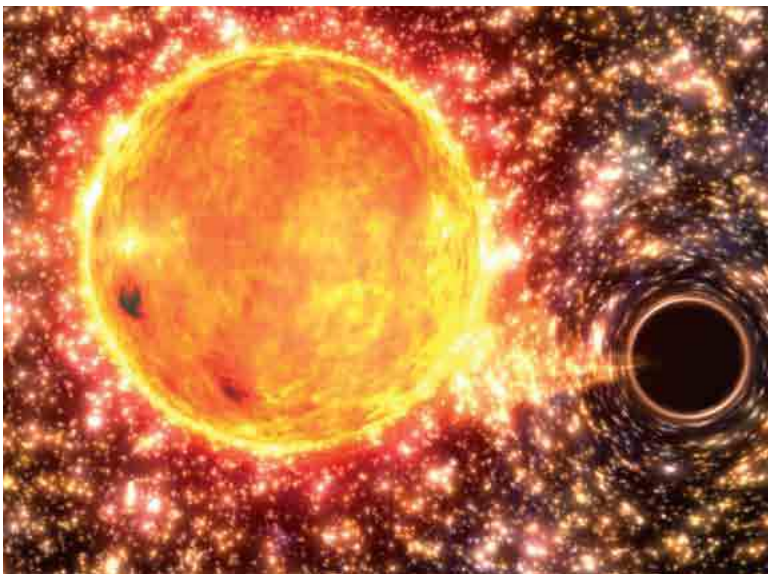
A new breed of spacecraft engine is undergoing its first indoor test flights, thanks to a giant 'wombat' on the outskirts of Australia's capital.

The Australian National University has developed a plasma thruster that uses electricity to ionise gas and produce thrust, allowing the engine to run for longer and with much less fuel than a chemical rocket.

This makes it ideal for manoeuvring satellites in orbit, or for extended voyages to places like Mars. However, rocket manufacturers need to be sure it works before trusting it on multimillion-dollar satellites.

Enter the thermal vacuum chamber dubbed 'Wombat XL', which is found on the top of Mount Stromlo, home to Canberra's historic observatory.

The five-metre long cylinder mimics the airlessness of space, as well as the dramatic temperature changes of over 250 degrees that a satellite experiences as it moves in and out of Earth's shadow.



"There's nowhere else in Australia that can do this," says Naomi Mathers, industry liaison engineer at the Advanced Instrumentation and Technology Centre, a new national facility that is also equipped for assembly and integration of orbital equipment.

The plasma thruster is the first of many customers for the centre, which will also test the three satellites that Australian universities are developing for launch in 2016, as part of the European Union's QB50 program.

"We're here to support the Australian space industry," says Naomi. "That means not only giving them a place to build and test equipment, but also helping to connect them with international collaborators."

For more information:

Advanced Instrumentation and Technology Centre,
Naomi Mathers,
Tel: +61 2 6125 1289,
naomi.mathers@anu.edu.au
www.rsaa.anu.edu.au

Australia's newest radio telescope

Fundamental questions about the Universe are set to be answered as a new radio telescope in outback Western Australia comes online, using multiple beam radio receiver technology to view the sky with unprecedented speed and sensitivity.

The Australian SKA Pathfinder (ASKAP), CSIRO's newest telescope, uses innovative phased array feed receivers, also known as 'radio cameras', to capture images of radio-emitting galaxies in an area about the size of the Southern Cross—far more than can be seen with a traditional radio telescope.

The telescope is currently nearing completion at the Murchison Radio-astronomy Observatory, 700 kilometres north of Perth. It comprises 36 antennas working together as a single instrument with higher resolution and sensitivity than any existing radio telescope. The antennas are connected by a high-speed optical fibre and linked to a supercomputer in Perth.

"ASKAP is a completely new type of telescope—everything is experimental—and it's all working remarkably well," explains ASKAP project scientist Lisa Harvey-Smith. "As part of early science activities, astrophysicists will use ASKAP to map distant galaxies, tracking their evolution over the past 10 billion years."

Not only is ASKAP a world-leading telescope in its own right, but it will ultimately be incorporated into the future Square Kilometre Array, the world's largest radio telescope, which is to be built in Australia and Southern Africa. The SKA will be powerful enough to see the first stars forming after the Big Bang.

For more information:

CSIRO Astronomy and Space Science,
Flornes Conway-Derley,
Tel: +61 2 9372 4339,
flornes.conway-derley@csiro.au
www.csiro.au/CASS

Monster black holes supersize their galactic greed

Monster black holes lurking in the centres of galaxies are hungrier than previously thought, Melbourne scientists have discovered.

Astrophysicist Alister Graham and his team at Swinburne University have revealed that these so-called supermassive black holes consume a greater portion of their galaxy's mass the bigger the galaxy gets. The discovery overturns the longstanding belief that these supermassive black holes are always a constant 0.2 per cent of the mass of all the other stars in their galaxy.

Alister and his colleagues found that the constant mass ratio rule was at odds with other properties that grow non-linearly with galactic size. Using new data gathered from the Hubble Space Telescope, the European Very Large Telescope in Chile and the Keck Telescope in Hawaii, they discovered that the ratio is only fixed for large galaxies formed when smaller, gas-poor galaxies merge.

"This non-linear growth is such that the black holes start out as much smaller seeds than previously realised," says Alister. "They then grow rapidly by accumulating gas that would otherwise go into making stars.

"While small galaxies can contain both a black hole and a dense, centrally located star cluster, the bigger galaxies only harbour massive black holes containing about 0.5 per cent of the galaxy mass," he says.

Interestingly, some galaxies are so small that they may contain the yet-to-be-observed 'intermediate mass' black holes, which lie between the supermassive monsters and those formed by collapsing stars.

Our own galaxy is relatively small, with a black hole only six million times the mass of the Sun. This was hard to explain under the old rules, which have now been updated to predict ratios of 10 or even 1,000 times less in the smallest galaxies.

This research was supported by Australian Research Council funding through grant FT110100263.

For more information:

Centre for Astrophysics and Supercomputing,
Faculty of Science,
Engineering and Technology,
Swinburne University of Technology,
Alister Graham,
Tel: +61 3 9214 8784,
agraham@astro.swin.edu.au
www.astronomy.swin.edu.au

PHOTOS: OPPOSITE PAGE: TOP: ARTIST'S IMPRESSION OF THE GIANT MAGELLAN TELESCOPE WITH THE LASER GUIDE BEAMS OF ITS ADAPTIVE OPTICS SYSTEM, CREDIT: GMTO CORPORATION; MIDDLE: CSIRO'S ASKAP ANTENNAS STAND AT THE MURCHISON RADIO-ASTRONOMY OBSERVATORY IN WESTERN AUSTRALIA, CREDIT: CSIRO; BOTTOM: VIEW OVER THE CORE OF CSIRO'S ASKAP TELESCOPE, CREDIT: CSIRO. THIS PAGE: ARTIST'S IMPRESSION OF A STAR BEING PULLED INTO A BLACK HOLE, CREDIT: GABRIEL PEREZ DIAZ; AUSTRALIAN PLASMA THRUSTER BEING TESTED IN THE SPACE SIMULATION FACILITY AT MOUNT STROMLO, CREDIT: NAOMI MATHERS, ANU.

For Women in Science

Serial cancer killers, how India and Australia split, and fingerprinting an epidemic were the research fields of three pioneering young scientists from Melbourne and Hobart who were awarded L'Oréal For Women in Science Fellowships in 2013.

And colour-changing dragons brought a second international L'Oréal For Women in Science honour for University of Melbourne evolutionary biologist Devi Stuart-Fox.

How India and Australia broke up

The end of any relationship can be rocky, but a Tasmanian geoscientist has dug into the ocean floor to understand how Australia, India and Antarctica parted ways 130 million years ago.

Joanne Whittaker, of the University of Tasmania, has examined ocean rocks from the Perth Abyssal Plain in an attempt to reconstruct the break-up of Gondwanaland and its formation of the three continents and the Indian Ocean.

She was awarded a 2013 L'Oréal Australia and New Zealand For Women in Science Fellowship in recognition of her research, which may help improve climate change models, find new gas resources and better understand our marine environment.

About 130 million years ago the Plain, around 1,600 kilometres off the coast of Geraldton, Western Australia, was the point at which India, Antarctica and Australia connected to form Gondwanaland. They then broke apart.

Satellite gravity data suggested the modern Plain includes two undersea plateaux, which when combined measure about half the area of Tasmania. Jo's project began with a successful bid for time on Australia's Marine National Facility research vessel *Southern Surveyor* to explore the area.

In November 2011, she and her colleagues from the University of Tasmania, Sydney University and Macquarie University found, mapped and sampled rocks from these plateaux, the Batavia and Gulden Draak Knolls, which tower about 3,000 metres above the abyssal plain itself.

"It looks like they split from the margins of the moving Indian Plate about 100 million years ago," says Jo.

She will use her Fellowship to have those rocks properly dated and identified, which will contribute to a broad reconstruction of the Indian Ocean basin.

"This model has to consistently account for geophysical and geological data across five continents, 130 million years and the entire Indian Ocean," Jo says.

For more information:

Institute for Marine and Antarctic Studies,
University of Tasmania,
Joanne Whittaker,
Tel: +61 3 6226 6367,
jo.whittaker@utas.edu.au
www.imas.utas.edu.au/people/profiles/current-staff/j/jo-whittaker

White cell assassins prove kiss of death for cancer

White blood cells have proven to be the serial assassins of the immune system, moving quickly on to their next target once they're released from a dying cancer cell's grip.

Misty Jenkins, of the Peter MacCallum Cancer Centre, has discovered that a T cell can only continue its killing spree once a targeted cancerous cell has signalled its imminent death and the T cell can unlock.

Misty's research, which was supported by a $25,000 2013 L'Oréal Australia and New Zealand For Women in Science Fellowship, will give us a greater understanding of our immune system and open the way to better managing T cells to defeat disease.

"A T cell locks onto a cancer cell when its receptor matches a specific protein fragment. It's a kiss of death," she says. "The T cell then introduces toxic enzymes into the cancer cell, which kills it."

Misty found that when T cells were genetically modified to lack the toxic enzymes, the killing process happened very slowly and the T cells did not detach and move on within the usual seven minutes.

She believes the T cell only moves on when the infected cell gives a signal of its imminent death, and she is now working to identify that signal.

Misty attended both Oxford and Cambridge universities following her PhD at the University of Melbourne. Now back in Melbourne, she's a National Health and Medical Research Council (NHMRC) postdoctoral fellow in the Cancer Cell Death laboratory at the Peter Mac.

For more information:

Peter MacCallum Cancer Centre,
Misty Jenkins,
Tel: +61 3 9656 3725,
misty.jenkins@petermac.org

www.petermac.org/research

Typhoid tips off new epidemic approach

A typhoid outbreak in Kathmandu has provided new insights into bacterial epidemics and antibiotic resistance, thanks to a Melbourne scientist's genomic research.

Kathryn Holt, of the University of Melbourne's Bio21 Institute, used genome sequencing to discover that an epidemic of deadly typhoid bacteria in Nepal's capital city was driven by climate, and not by the outbreak of novel genetic strains.

Her research, published in the Royal Society journal *Open Biology*, changes our understanding of how typhoid spreads and how we can better respond to other bacterial epidemics.

Kat says the discovery could only have happened through her sequencing of the bacterium's whole genome. "It's a very recently emerged pathogen, so there's little genetic variation to track. To get anywhere with it, you have to sequence everything," she says.

During her research, Kat was surprised to find that members of the same Kathmandu family each had different strains of the bacterium; it wasn't a single strain that spread between them. Instead, she found climate mainly drove infection increases.

"In the wet season, you get flooding and the drinking water becomes contaminated, so you get transmission and a lot of infections across the city. That means, in the one season you have infections caused by a whole variety of genetically different typhoid bacteria," Kat says.

Her achievements won her a 2013 L'Oréal Australia and New Zealand For Women in Science Fellowship, which she will use to study the origin, evolution and spread of antibiotic resistance in *Klebsiella*—a bacterium that is rapidly becoming a problem in hospitals worldwide because of its capacity for survival in a broad range of environments and its ability to pick up novel genes.

For more information:

Bio21 Institute,
The University of Melbourne,
Kathryn Holt,
Tel: +61 3 9035 3155,
kholt@unimelb.edu.au

www.biochemistry.unimelb.edu.au/research/res_holt.html

Infrared gets under dragon skin

Bearded dragons are revealing some of the secrets behind their colour-changing ways, thanks to the work of a Melbourne evolutionary scientist.

Devi Stuart-Fox has discovered that bearded dragons change colour in response to heat, allowing them to regulate their body temperature.

Her research opens the way for scientists to imitate lizards and develop materials that respond to light and temperature for solar energy, sensor and biomedical applications.

"It's cool watching lizards, insects and octopuses change colour, but we know so little about how and why they do it. So, we're working with Australian bearded dragons to understand more about it," says Devi, a senior lecturer in zoology at the University of Melbourne.

As part of her research, Devi measured the dragons' near-infrared radiation to understand the mechanism behind their changing colour.

Near-infrared light is associated with heat rather than colour. These wavelengths are invisible to animals, but affect their body temperature.

"These wavelengths are significant because they affect how the lizards reflect or absorb heat. By changing colour in both visible and near-infrared wavelengths, the lizards could simultaneously optimise their camouflage and thermal balance," she says.

Last year, Devi was awarded her second international L'Oréal For Women in Science honour—the 2013 L'Oréal-UNESCO International Special Fellowship, worth $40,000. Ten years earlier she received a UNESCO-L'Oréal International Fellowship, which supported a study of chameleons in South Africa.

In 2013, her research on colour-changing bearded dragons also earned her an Australian Research Council grant that will fund an international research initiative she is leading.

For more information:

The University of Melbourne,
Devi Stuart-Fox,
Tel: +61 3 8344 4846,
devis@unimelb.edu.au

www.scienceinpublic.com.au/loreal/media-releases/lizards

For Women in Science
FONDATION L'ORÉAL

PHOTOS: OPPOSITE PAGE: LEFT: JOANNE WHITTAKER, CREDIT: L'ORÉAL AUSTRALIA/SDPMEDIA.COM.AU; RIGHT: DEVI STUART-FOX WITH A BEARDED DRAGON, CREDIT: L'ORÉAL AUSTRALIA/SDPMEDIA.COM.AU. THIS PAGE: MISTY JENKINS, CREDIT: L'ORÉAL AUSTRALIA/SDPMEDIA.COM.AU; A BEARDED DRAGON, *POGONA VITTICEPS*, CREDIT: DEVI STUART-FOX; KATHRYN HOLT, CREDIT: L'ORÉAL AUSTRALIA/SDPMEDIA.COM.AU.

Glucosamine study raises fertility concerns

Research on the effects of the popular joint supplement glucosamine has raised fears for women's fertility, and a knee-jerk reaction from the vitamin industry, as Adelaide scientists reveal its threat to conception.

Jeremy Thompson and a team from the Robinson Research Institute, University of Adelaide, found that glucosamine increased the possibility of congenital abnormalities and reduced foetus and litter size when it was injected into mice before conception.

"There are concerns that women who take glucosamine and who are trying to conceive may be reducing their chances of conception," says Jeremy. "We are particularly concerned that it could increase problems in people with diabetes."

The study, which was published last year in the journal *Reproduction, Fertility and Development*, had garnered vitamin industry vitriol.

"The industry came out strongly against our preliminary findings, but we have increasing amounts of data that supports what we're proposing," Jeremy says.

Glucosamine, which is taken as a dietary supplement for joint health and added to many energy drinks, is an amino sugar that mimics hyperglycaemia by interfering with the normal activity of a glucose-sensing pathway.

Jeremy and his team used glucosamine to investigate how diabetes negatively affects foetal development around conception.

"Glucosamine has been a very powerful tool for manipulating a metabolic pathway highly associated with diabetes," says Jeremy. "And we found glucosamine has a dramatic impact on egg and embryo health."

With the help of a new ARC Centre of Excellence grant for the Centre for Nanoscale BioPhotonics, the team aims to better understand the links between hyperglycaemia, embryo development and intergenerational health.

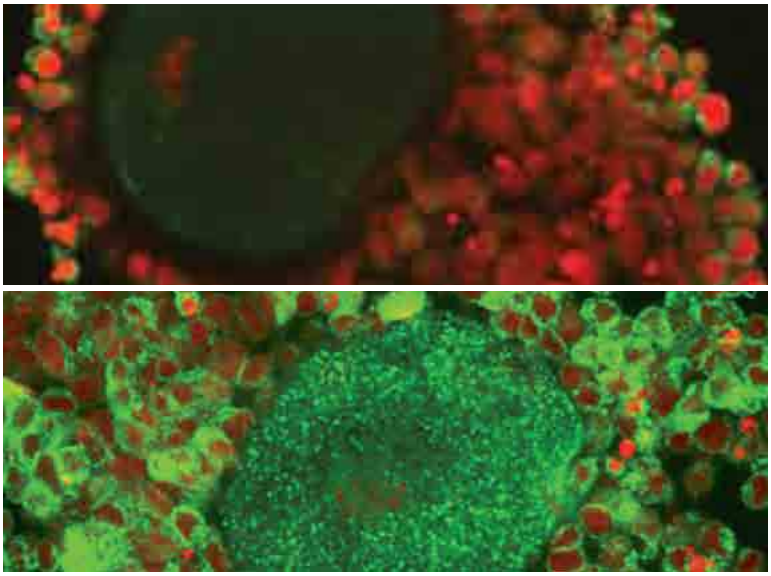
For more information:

Robinson Research Institute,
The University of Adelaide,
Jeremy Thompson,
Tel: +61 8 8313 8152,
jeremy.thompson@adelaide.edu.au
www.adelaide.edu.au/directory/jeremy.thompson

Obese dads leave kids with fat chance

An obese father increases the risk of his children and grandchildren becoming obese, even if they follow a healthy diet. That's the implication of a series of mouse studies conducted at the University of Adelaide.

The researchers found that a father's high-fat diet could change the molecular make-up of his sperm, leading to obesity and diabetes-like symptoms in two generations of offspring.



"With obese fathers, changes in the sperm's microRNA molecules are linked with programming the embryo for obesity or metabolic disease later in life," says Tod Fullston, the study's lead author and an NHMRC Peter Doherty Fellow with the University of Adelaide's Robinson Research Institute.

Compared with control-fed mice, male mice fed a 10-week high-fat diet passed on a higher rate of metabolic disorders, including obesity, to their children and grandchildren. The effect was seen even though all the mice, apart from the original test father mice, were fed a healthy control diet.

However, the transmission of obesity, insulin resistance and impaired glucose tolerance to each generation was sex-specific. In the first generation, the females predominantly inherited obesity while both sexes inherited the metabolic defects.

First generation males then transmitted obesity and insulin resistance to their daughters and first generation females transmitted obesity and impaired metabolic health to their sons.

"If our laboratory studies are translatable to humans, this could be a new intervention window into the epidemic of childhood obesity," says Tod.

For more information:

Robinson Research Institute,
The University of Adelaide,
Tod Fullston,
Tel: +61 8 8313 8188,
tod.fullston@adelaide.edu.au

www.adelaide.edu.au/directory/tod.fullston

Preterm birth linked to teen school angst

Large numbers of premature-born children may be slipping under the radar, say researchers who have found brain development problems in teenagers deemed clinically normal after a late preterm birth.

Julia Pitcher and Michael Ridding, of the Robinson Research Institute, University of Adelaide, found that children born even one to five weeks premature showed reduced 'neuroplasticity' as teenagers. Their study provides the first physiological evidence of the link between late preterm birth and reduced motor, learning and social skills in later life.

Neuroplasticity is the brain's ability to create new neural pathways and alter existing ones to learn new information, and this brain network connectivity is fundamental to learning and memory.

The study of 28 teenagers aged 13-14 years old looked at early preterm (before 33 weeks), late preterm (33-37 weeks) and term-born children (38-41 weeks). However, Julia and Michael were particularly interested in the late preterm results.

"Using a brain stimulation technique, we found that even being born mildly preterm really blunted the brain's ability to change the strength of its connections," says Julia.

For more information:

Robinson Research Institute,
The University of Adelaide,

Julia Pitcher,
Tel: +61 8 8313 1301,
julia.pitcher@adelaide.edu.au

Michael Ridding,
Tel: +61 8 8313 7592,
michael.ridding@adelaide.edu.au

Gastro discovery leads to worldwide vaccine rollout

Fifty million children in the world's poorest countries will be vaccinated against the deadly rotavirus by 2015, thanks to the breakthrough work of a quiet Melbourne researcher.

Ruth Bishop's rotavirus discovery led to the development of the vaccine currently being rolled out by the Global Alliance for Vaccines and Immunisation—and to her declaration as 2013 CSL Florey Medal winner.

Each year, around half a million children die from rotavirus infection and the acute gastroenteritis it causes.

Ruth started her hunt for the cause of 'gastro' at Melbourne's Royal Children's Hospital (RCH) in 1965, making the rotavirus discovery with her colleagues at the RCH and the University of Melbourne in the early '70s.

The breakthrough initiated a life's work for Ruth: understanding the virus, working out how it spreads, and fighting back with treatments and vaccines.

And the current vaccine rollout, which is supported by the Bill and Melinda Gates Foundation, is already achieving results. Figures from Bolivia, the first low-income country to take part in the rollout, have shown a three-quarter drop in hospitalisations from rotavirus.

Yet Ruth, now in her eighties, won't be fully satisfied until a new vaccine, currently being trialled in Indonesia and New Zealand, becomes available. It's intended for newborns: "The only time children in many developing countries are likely to be near a hospital," she says.

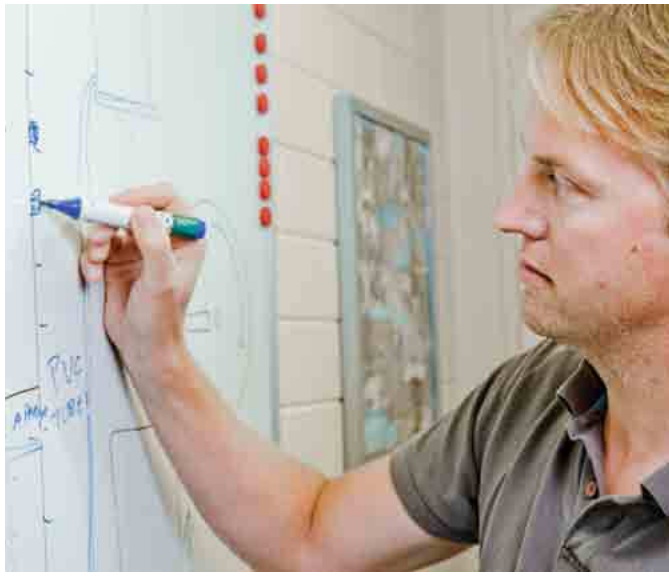
The CSL Florey Medal is a $50,000 biennial award made by the Australian Institute of Policy and Science and sponsored by CSL. It honours Australian researchers who have made significant achievements in biomedical science and/or in advancing human health.

For more information:

CSL Florey Medal,
Camille Thomson,
Australian Institute of Policy and Science,
director@aips.net.au,
Tel: +61 2 9351 0819

www.aips.net.au/news-events/the-florey-medal

PHOTOS: OPPOSITE PAGE: LEFT: (TOP AND BOTTOM) CHILDREN BORN EVEN ONE TO FIVE WEEKS PREMATURE CAN SHOW REDUCED SKILLS LATER IN LIFE; RIGHT: GLUCOSAMINE MAY AFFECT FERTILITY. THIS PAGE: LEFT: GREEN STAINING IN A GLUCOSAMINE-TREATED EGG (BOTTOM) SHOWS INCREASED ACTIVITY IN THE GLUCOSE-SENSING PATHWAY COMPARED WITH A CONTROL (TOP), CREDIT: ROBINSON RESEARCH INSTITUTE; RIGHT: RUTH BISHOP, CREDIT: STEPPING STONE PICTURES.



Land clearing harms Reef water quality

Coastal land clearing has led to poor water quality in the Great Barrier Reef lagoon and threats to reef animals, according to the first data providing evidence of the damage.

The Water Quality and Ecosystem Health research team at the Australian Institute of Marine Science has collected 20 years of data, which shows the connection between high rates of land clearing and reduced reef water quality in the late 1990s and early 2000s.

"Our analyses show that water quality in the lagoon dropped significantly during the late 1990s and early 2000s, a period that coincided with very high rates of vegetation clearing on land adjacent to rivers," says research team leader, Britta Schaffelke.

"It also included three major river floods. This is the first direct evidence that catchment activity affects marine water quality," she says.

According to Britta, reef water quality is critically important for a healthy ecosystem.

"When water quality deteriorates, we see deterioration of important habitats such as coral reefs and seagrass beds, and these are home to many species of reef fish, crustaceans and marine mammals," she says.

The research shows that seasonal processes, such as strong winds and river floods, drive water quality in the lagoon, particularly turbidity, or cloudiness due to suspended particles. Land use in the catchment also affects the sediment and nutrient content of river floodwater that empties into the lagoon.

Water quality typically declines rapidly over the wet season, as rivers bring in sediment and nutrients, but improves again after floods as sediment settles or is carried out of the lagoon.

Reducing the load carried by coastal rivers would improve the reef's water clarity, says Britta.

For more information:

Australian Institute of Marine Science,
Britta Schaffelke,
Tel: +61 7 4753 4382,
b.schaffelke@aims.gov.au

www.aims.gov.au/docs/research/water-quality/position-paper.html

No place like home as reef critters face extinction

Coral reef organisms that help build homes for thousands of other species face extinction by 2100, thanks to increased CO_2 levels and ocean acidification.

Researchers from the Australian Institute of Marine Science have discovered that ocean acidification around naturally occurring CO_2 seeps in Papua New Guinea offer a glimpse of a future high-CO_2 world and its impact on coral reef ecosystems, including the possible complete loss of creatures called Foraminifera, or forams.

"We found no Foraminifera species at all where acidification had reached the predicted level of our oceans in 2100, in all but the most optimistic emissions scenarios," says Sven Uthicke, a senior research scientist.

Forams are amoeba-like organisms covered in shells. These shells make up to 40 per cent of some cays or sandy sea beds of coral reefs—the home to many coral reef species.

The team discovered that foram communities close to the high-CO_2 seeps had lower species diversity and were less abundant than those 500 metres away. It also found that foram shells were corroded or 'pitted' by the acidic environment.

"Forams are particularly vulnerable to ocean acidification as they lack the complexity and energy reserves of other marine creatures with carbonate skeletons, such as corals and sea urchins."

But the corals also showed the effects of increasing acidity, with branching and leaf-like corals being replaced by simpler, boulder-like species close to the seeps.

"The decline of the structurally complex corals means the reefs will be much simpler and there will be less habitat for the hundreds of thousands of species we associate with today's coral reefs," says study leader Katharina Fabricius.

For more information:

Australian Institute of Marine Science,
Steve Clarke,
Tel: +61 7 4753 4264,
media@aims.gov.au

www.aims.gov.au/co2_seeps

Fresh water bounty under the sea

Future global water shortages could be alleviated by huge freshwater reserves discovered beneath the ocean floor, according to a team of Australian and international scientists.

The scientists from Adelaide, the Netherlands, USA and the UK have found half a million cubic kilometres of fresh water in undersea aquifers located off Australia, China, North America and South Africa.

These aquifers are similar to the groundwater used in much of Australia and the rest of the world for drinking water and irrigation, and so could come in handy as existing supplies dwindle.

"The volume is a hundred times greater than the amount we've extracted from the Earth's sub-surface in the past century since 1900," says lead researcher Vincent Post, of Flinders University. "It could sustain some regions for decades."

He says scientists previously considered these reserves rare, but the number and volume of the aquifers suggested that their formation was commonplace.

According to Vincent, they were probably filled by rainwater filtering into the water table during the last ice age, when these areas were above the lower sea level of the time.

The research team discovered the reserves by analysing previous seafloor water studies, some done for oil and gas exploration. The offshore drilling used to extract these fossil fuels could also reach these new water supplies, at a cost competitive with desalinating seawater.

However, there is a word of caution—these new reserves are non-renewable.

"We should use them carefully. Once gone, they won't be replenished until the sea level drops again, which is not likely to happen for a very long time," says Vincent.

For more information:

National Centre for Groundwater Research and Training,
Flinders University,
Vincent Post,
Tel: +61 8 8201 5077,
vincent.post@flinders.edu.au

www.groundwater.com.au

Insect wings beat superbugs

Nanoscale spikes on dragonfly wings are inspiring materials that kill bacteria, including deadly antibiotic-resistant golden staph (*Staphylococcus aureus*).

Elena Ivanova and her fellow researchers at Swinburne University of Technology were studying self-cleaning surfaces in nature when they discovered bacteria being killed on the wings of the clanger cicada, *Psaltoda claripennis*, a species mostly found in Queensland.

The secret seemed to lie in millions of tiny rounded spikes, or nanopillars, each a thousand times smaller than the width of a human hair.

"Imagine a water balloon sagging between blunt nails," says Russell Crawford, one of Elena's colleagues and dean of science. "The bacterial cell wall stretches between the nanopillars and eventually it breaks."

They soon found similar structures on the wings of the wandering percher dragonfly, *Diplacodes bipunctata*. A chance conversation with an engineering colleague Saulius Juodkazis then led them to the ominously named black silicon, which was being evaluated for use in solar cells due to the light-absorbing qualities of its own spiky surface.

Both the dragonfly wings and black silicon are even better than cicada wings at killing bacteria, dispatching more varieties and even destroying their spores, which are otherwise nearly impossible to kill.

Because these surfaces shred the bacteria using a physical rather than chemical mechanism, they have great potential for use in hospitals, where antibiotic-resistant superbugs are a growing threat.

"We want to be able to create medical implants with antibacterial surfaces so that we can place them in the body without the risk of infection," says Russell.

For more information:

Swinburne University of Technology,
Lea Kivivali,
Tel: +61 3 9214 5428,
lkivivali@swin.edu.au

www.swinburne.edu.au/science-engineering-technology

From sea snails to electronic free circuits

Sea snails and sponges are shedding light on how to create electronic-free circuitry and environmentally friendly optical fibre, say Geelong scientists.

Inspired by the materials these sea creatures make, an Australian-US team is trying to create 3D gold nanoparticle arrays that channel light.

"Effectively we are creating circuitry without electronics," says Tiffany Walsh, Veski Innovation Fellow and one of the researchers from Deakin University.

Tiffany is harnessing the power of supercomputers at the Victorian Life Sciences Computation Initiative to understand how simple creatures like molluscs are able to make materials far more advanced than we can.

"The nacre (mother-of-pearl) in their shells is made of calcium carbonate, which is essentially just chalk, held together by a small amount of organic glue," says Tiffany. "Somehow these two very soft materials become something very hard when they're combined."

According to Tiffany, the secret seems to be in the way the materials self-organise when mixed, with biological mortar holding together tiny calcium carbonate bricks.

She is taking inspiration from this process to make gold nanoparticles form into three-dimensional arrays, which act as waveguides to channel light.

After simulating the nanoparticles' interaction with biological molecules on the supercomputer, Tiffany shares and exchanges her findings with American colleagues at the Universities of Buffalo and Miami, who then make the materials.

"Green manufacturing is the dream," says Tiffany. "If we can find out how they do this, we can create new, high-performance materials in a less expensive way and without hazardous by-products."

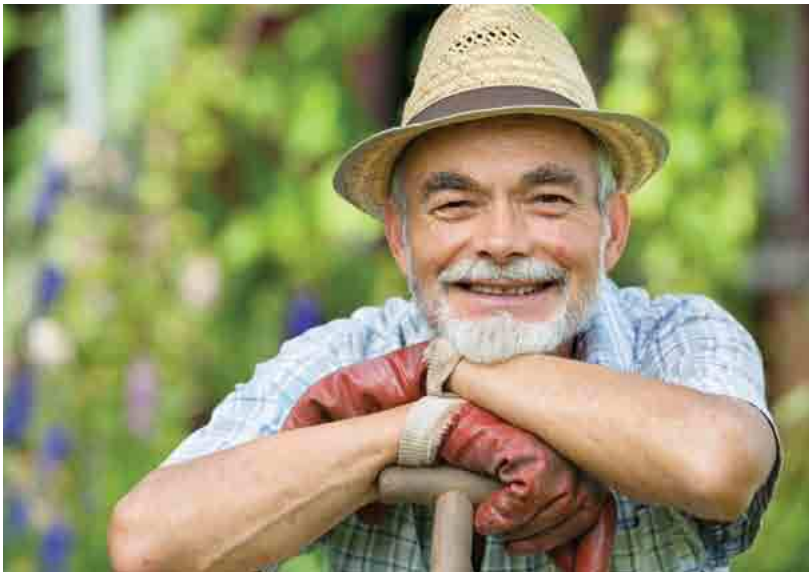
For more information:

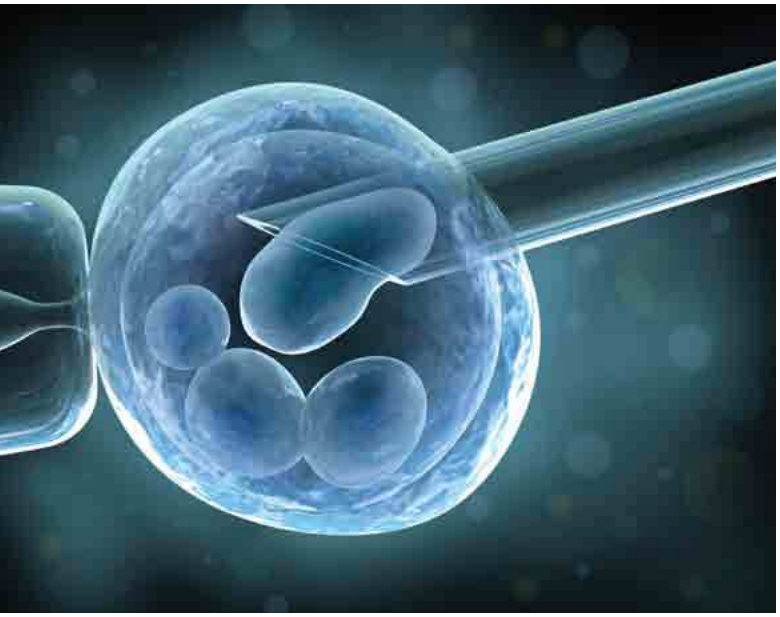
Deakin University,
Tiffany Walsh,
Tel: +61 3 5227 3116,
tiffany.walsh@deakin.edu.au

www.deakin.edu.au/research/ifm

PHOTOS: OPPOSITE PAGE: LAND CLEARING AND ACIDIFICATION THREATEN THE GREAT BARRIER REEF; BUBBLES OF CO2 RISE FROM A NATURAL SEEP IN PNG, CREDIT: K.FABRICIUS © AIMS; VINCENT POST, CREDIT: NATIONAL CENTRE FOR GROUNDWATER RESEARCH AND TRAINING. THIS PAGE: WANDERING PERCHER DRAGONFLY, *DIPLACODES BIPUNCTATA*, CREDIT: JEAN, VIA ENCYCLOPEDIA OF LIFE (CC BY-NC); THE STRUCTURE OF A SEA SNAIL'S MOTHER-OF-PEARL LAYER SUGGESTS HOW TO CHANNEL LIGHT.

Regenerative medicine





Axolotls out on limb for future human hope

An axolotl's ability to regrow limbs and repair brain and heart tissue could shed light on how humans might one day do the same, after Melbourne scientists discovered the key role played by macrophages, immune system cells, in the animal's regenerative process.

James Godwin and his colleagues at the Australian Regenerative Medicine Institute (ARMI) have identified the critical role of macrophages in axolotl tissue regeneration, raising the hope of future treatments for human spinal cord and brain injuries, as well as heart and liver disease.

"We need to find out exactly how the macrophages are contributing to regeneration. Down the road, this could lead to therapies that tweak the human immune system into a more regenerative pathway," James says.

Axolotls, a type of salamander, are known for their ability to regrow limbs and regenerate spinal cord, brain and heart tissue. The healed limb or tissue is completely functional and scar-free.

James and his team discovered that when they removed axolotls' macrophages, the animals lost their ability to regenerate limbs and they formed scar tissue instead.

James also believes that studying the animal's regenerative processes could lead to new treatments for several common conditions linked to fibrosis or scarring, such as heart and liver diseases.

Promotion of scar-free healing would also dramatically improve patient recovery after surgery.

James is an independent research fellow in Nadia Rosenthal's ARMI laboratory at Monash University, and he has been instrumental in setting up a breeding colony of axolotls to study regeneration further.

"We need to know exactly what salamanders do, and how they do it so well, so we can reverse-engineer that capacity into human therapies."

For more information:

Australian Regenerative Medicine Institute,
James Godwin,
Tel: +61 3 9902 9644,
james.godwin@monash.edu.au

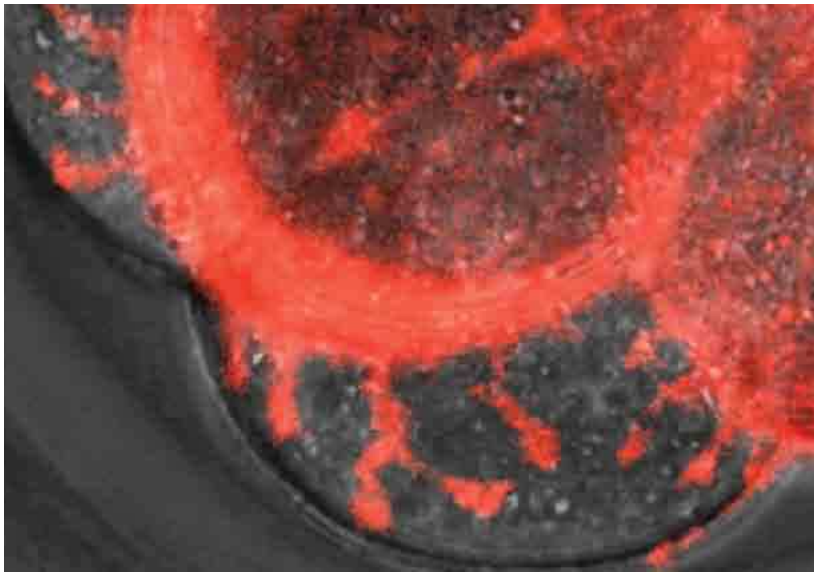
www.armi.org.au/About_Us/Staff/James_Godwin.aspx

Your first hug

Most people remember their first kiss but Victorian scientists have discovered that your first hug is much further back than you think.

Nicolas Plachta and his team at the Australian Regenerative Medicine Institute have discovered that embryos, when only eight cells in size, develop arm-like structures that 'hug' the cells into shape, helping to determine an embryo's ultimate success.

The study, which was published in the journal *Nature Cell Biology*, used live imaging and fluorescent markers to capture the action in mouse embryos.



The pictures and video show the arm-like structures, or filopodia, appearing on the outer membrane of some cells before reaching out and pulling the cells closer together. Only after the filopodia release their grip do the cells continue to divide.

"In a sense, these filopodia are hugging the cells, squeezing them into shape," says Nicolas.

The Plachta group is now hoping to improve the success rates of IVF implantation with this discovery. They are designing non-invasive imaging approaches to see whether IVF human embryos form normal filopodia and undergo normal compaction.

"This could help us choose which embryos should be implanted back in the uterus," says Nicolas.

Nicolas is an EMBL Australia research leader, recruited by global search and appointed for up to nine years in accordance with the successful model developed by the European Molecular Biology Laboratory (EMBL). Australia has four EMBL Australia research groups. The first two, including the Plachta group, are located at the Australian Regenerative Medicine Institute at Monash University. The next two groups have recently been established at the South Australian Health and Medical Research Institute.

For more information:

EMBL Australia,
Nicolas Plachta,
Tel: +61 3 9902 9612,
nicolas.plachta@monash.edu.au

www.plachtalab.com

Stem cell memory to help tailor regenerative medicine

A Melbourne scientist is harvesting the memory found in reprogrammed adult cells to develop cell therapy techniques that have the potential to cure a number of diseases.

Jose Polo, of Monash University, has found that induced pluripotent stem (iPS) cells don't lose all their memory after reprogramming, flagging the possibility that a better understanding of these stem cells will aid regenerative medicine.

"Basically an iPS cell derived from muscle is more likely to reprogram back into muscle cells, while iPS cells derived from skin will generate skin cells," says Jose. "And this could influence what type of iPS cell you might choose to generate a specific cell type."

Embryonic stem cells, which can become almost any type of cell in the body, are known as pluripotent. They hold remarkable potential for regenerative medicine and drug development.

Induced pluripotent stem cells are adult cells that have been reprogrammed to an embryonic stem cell-like state, and provide an alternative to the controversial use of embryonic cells in medicine.

It is clear that epigenetic modification—heritable changes in gene activity caused by changes outside the DNA sequence—is fundamental to both cell differentiation and cell reprogramming.

Jose has shown that iPS cells retain an epigenetic memory of their donor cells. Now his research group is exploring this memory to work out how to derive a variety of adult cells in the lab.

Jose is based at the Australian Regenerative Medicine Institute and the Department of Anatomy and Developmental Biology at Monash University, and in 2013 won a Victorian Tall Poppy Science Award and a Sylvia and Charles Viertel Senior Medical Research Fellowship for his research.

For more information:

Australian Regenerative Medicine Institute,
Jose Polo, Tel: +61 3 9905 0005,
jose.polo@monash.edu.au

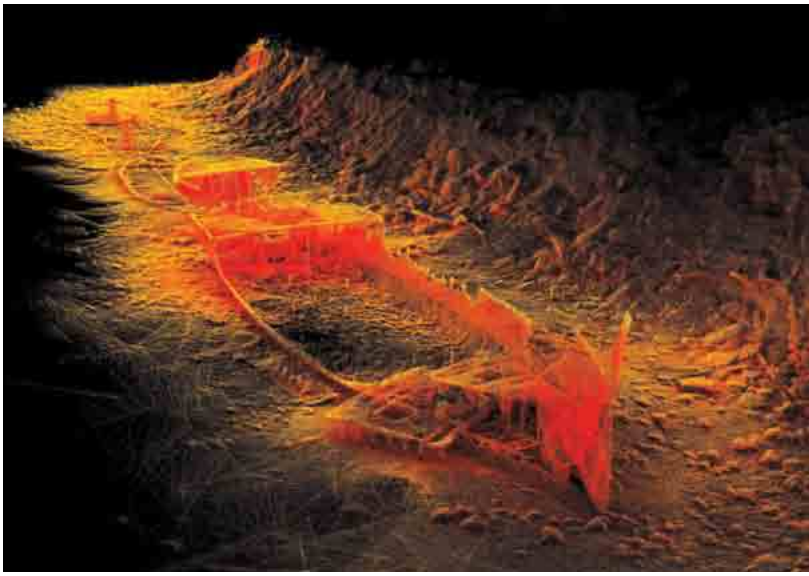
www.armi.org.au/About_Us/Staff/Jose_Polo.aspx

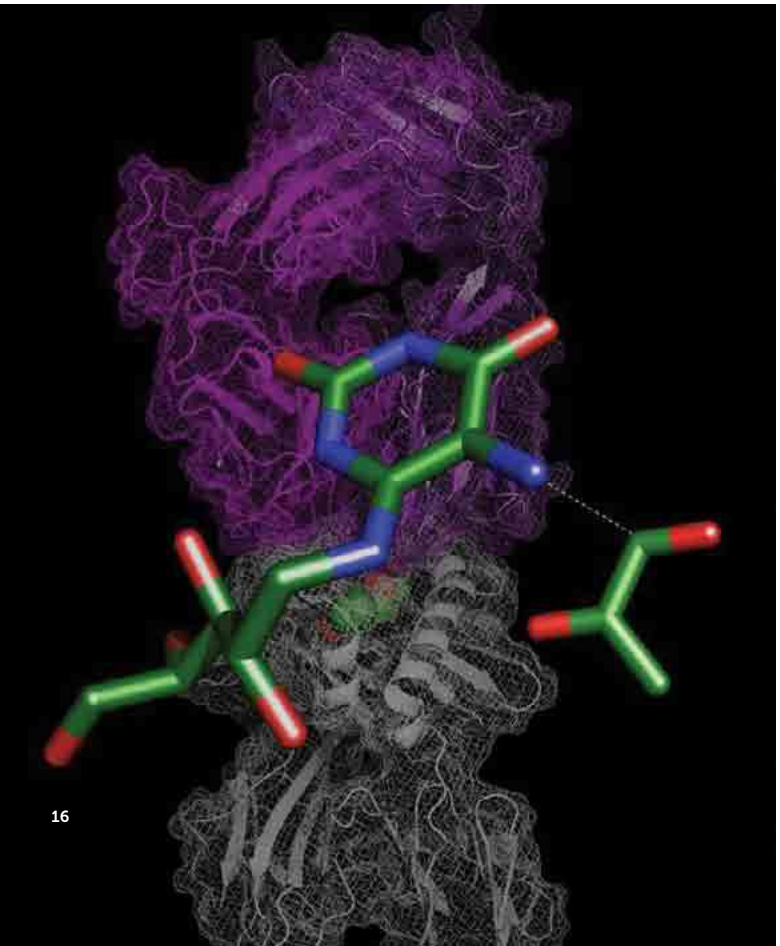
MONASH University | ARMI AUSTRALIAN REGENERATIVE MEDICINE INSTITUTE

PHOTOS: OPPOSITE PAGE: TOP: REGENERATIVE MEDICINE OFFERS HOPE FOR LONGER, HEALTHIER LIVES; MIDDLE: NICOLAS PLACHTA'S RESEARCH MAY IMPROVE IVF SUCCESS RATES; BOTTOM: AXOLOTLS ARE KNOWN FOR THEIR ABILITY TO REGROW LIMBS. THIS PAGE: IPS CELLS EXPRESSING A GREEN FLUORESCENT PROTEIN INDICATING THE REACTIVATION OF THE OCT4 PLURIPOTENT GENE, CREDIT: JOSE POLO; THE ARM-LIKE FILOPODIA 'HUG' THE EMBRYO'S CELLS, SQUEEZING THEM INTO SHAPE, CREDIT: EMBL AUSTRALIA.

Eureka Prizes

The 2013 Australian Museum Eureka Prizes recognised some amazing inventions that are saving lives and solving big issues for industry. Here are some of the highlights. You can see all the winners at australianmuseum.net.au/2013-winners-eureka





Vitamin B reveals the role of mystery gut immune cells

An accidental discovery by Melbourne researchers has revealed the purpose of 'mystery' immune cells in the gut, shown how our immune system interacts with the complex bacteria ecology found there, and opened new paths for drug discovery.

Our guts, lungs and mouths are lined with mysterious immune cells that make up to 10 per cent of the T cells in our immune system. These immune cells, known as mucosal-associated invariant T cells (MAITs), detect reactive intermediates in the synthesis of vitamin B2 (riboflavin) that is made by many invasive bacteria and fungi.

Humans and other mammals use, but do not make, riboflavin, so the presence of these precursors indicates invasive bacteria or fungi. That's when the MAIT cells swing the immune system into action against foreign invaders.

The team, from the University of Melbourne and Monash University, won the 2013 Australian Museum University of New South Wales Eureka Prize for Scientific Research.

"In the spirit of Pasteur, the team exploited an accidental discovery to reveal a new paradigm for how our immune system can function," Frank Howarth, director of the Australian Museum, says.

The team members are continuing their work as part of a new Australian Research Council Centre of Excellence in Advanced Molecular Imaging.

Native shrubs good for sheep and the environment

Feeding livestock on native plants is the key to sustainable profits for Australian farmers, researchers have found.

Farmers in dry parts of southern Australia are planting native perennial shrubs to feed their animals following ground-breaking research by the Future Farm Industries CRC Enrich Project Team.

For its role in initiating this change, the Enrich team has won the 2013 Australian Museum Caring for our Country Landcare Eureka Prize for Sustainable Agriculture.

A bug that stops dengue

Dengue fever is on the march and threatening the growing populations of Asia and even northern Australia. But a 'vaccine' for mosquitoes could stop it in its tracks.

A team of researchers from Melbourne, Brisbane, Cairns and Brazil has found a bacterium, *Wolbachia*, in fruit flies, which could stop mosquitoes from spreading dengue.

For their breakthrough in insect-borne disease control, the Eliminate Dengue team, led by Scott O'Neill from Monash University, has won the 2013 Australian Museum Australian Infectious Diseases Research Centre Eureka Prize for Infectious Diseases Research.

"This work is a potential game-changer in the battle against dengue and other insect-borne diseases," the director of the Australian Museum, Frank Howarth, says.

Walking again

Children with a deadly muscle-wasting disease are regaining the ability to walk and potentially avoiding life-threatening complications, thanks to a new treatment developed by researchers at Perth's Murdoch University.

The treatment, developed by Steve Wilton and Sue Fletcher, targets the genetic defect responsible for Duchenne muscular dystrophy, a condition that affects around one in 3,500 boys.

For bringing their drug from laboratory bench to bedside, Steve and Sue have won the 2013 Australian Museum NSW Health Jamie Callachor Eureka Prize for Medical Research Translation.

The dingo: from sinner to saviour

Dingoes play a vital role in reducing damage caused by kangaroos, foxes and feral cats, according to University of Tasmania's Chris Johnson and his colleagues.

They've discovered that Australia's dingoes, far from being vermin, sustain biodiversity and can help land managers control kangaroo populations and suppress invasive species.

For their innovative approach to conservation, Chris and his team have won the 2013 Australian Museum NSW Office of Environment and Heritage Eureka Prize for Environmental Research.

Mill mapper keeps mines working

If your pepper mill wears out, it's annoying. But for mines it's disastrous when their grinders can no longer smash rocks, often costing them $100,000 an hour in downtime.

Now, a three-dimensional laser system, which takes 10 million measurements in 30 minutes, can take over the dangerous work of manually evaluating mining machinery conditions.

Researchers at Curtin University have developed two systems using 3D laser imaging to map the internal wear of crushers and grinders, allowing operators to make better decisions about maintenance and repair as well as improving efficiency and safety and saving big money.

Scanalyse, the company they founded, now sells the technology to dozens of companies around the world.

Scanalyse/Outotec won the 2013 Australian Museum Rio Tinto Eureka Prize for Commercialisation of Innovation for the creation of MillMapper and CrushMapper.

Zebedee bounces around, mapping as he goes

Now you can map a mine, cave, building or forest just by walking through it with Zebedee in your hand.

CSRIO scientist Elliot Duff and his colleagues developed a spring-mounted hand-held laser scanner that can make 3D images of spaces previously impossible to map.

The group call themselves the Zebedee Team, in honour of the spring-loaded host of the popular children's TV program, The Magic Roundabout.

For their creative solution, Elliot and his colleagues have won the 2013 Australian Museum ANSTO Eureka Prize for Innovative Use of Technology.

Here be dragons: winning shots of sea life

A stunning shot of a male weedy sea dragon incubating eggs has earned amateur photographer Richard Wylie, from Safety Beach in Victoria, the 2013 Australian Museum New Scientist Eureka Prize for Science Photography.

The Eureka Prize is Richard's second major award for his photographs of the intriguing sea creatures, which live in Victoria's Port Phillip Bay.

For Mr Wylie, the opportunity to take pictures of the sea dragons (*Phyllopteryx taeniolatus*) represents a happy collision of hobby, work and study. He is a marine biologist and director of the Euakafa Island Research Centre, a marine science study centre in Tonga.

Providing the very stuff of protection

From keeping Australian troops safe from explosions, to ensuring military vehicles can maintain flexibility on damaged roads, the Armour Applications Program of the Defence Materials Technology Centre has pioneered high-performance materials.

The team's collaborative research has used computer modelling, explosives, high-speed cameras and new welding techniques to develop technologies and systems with improved blast performance, reduced weight and greater flexibility.

"These new materials and manufacturing techniques are already protecting Australian troops in Afghanistan," the director of the Australian Museum, Frank Howarth, says.

For their contributions to safety and performance, the Armour Applications Program has won the 2013 Australian Museum Defence Science and Technology Organisation Eureka Prize for Outstanding Science in Safeguarding Australia.

PHOTOS: OPPOSITE PAGE: TOP: A 3D LASER SCAN BY ZEBEDEE OF THE WRECK OF THE HMQS *GAYUNDAH*, AT REDCLIFFE, QUEENSLAND, CREDIT: CSIRO; MIDDLE: WEEDY SEA DRAGON, CREDIT: RICHARD WYLIE; BOTTOM: T CELL ACTIVATION BY TRANSITORY ANTIGENS, CREDIT: JEFFREY MAK, UNIVERSITY OF QUEENSLAND. THIS PAGE: BUSHMASTER ARMY VEHICLES ARE KEEPING AUSTRALIAN TROOPS SAFE, CREDIT: AUSTRALIAN DEFENCE DEPARTMENT; DINGOES HELP SUSTAIN BIODIVERSITY.

Bubbles capture minerals and toxic algae

A radical flotation technology has earned Australia over $4 billion in mineral exports each year by improving mineral particle recovery from wastewater.

Chemical engineer Graeme Jameson, AO, of the University of Newcastle, developed the technology, which was first used in mineral processing plants and is now being applied to other industrial practices.

He was named 2013 NSW Scientist of the Year for his innovation.

The technology, developed in the late 1980s, is used in over 300 plants across 25 countries. It's also being used in the extraction of oil from tar sands in Canada and the removal of blue-green algae from waterways in Central Australia.

Graeme is director of the University of Newcastle's Centre for Multiphase Processes.

Shine on you tiny diamond

Tiny diamonds have been used to track single atoms and molecules inside living cells.

A University of Melbourne team has developed a device that uses nanoscale diamonds to measure the magnetic fields from a living cell's atoms and molecules, with resolution a million times greater than current magnetic resonance imaging.

Their work, which opens the possibility of improved medicine delivery by tracking molecules inside cells, won the team a 2013 Eureka Prize, as well as a $50,000 Victoria Prize for their leader, Lloyd Hollenberg.

A malaria vaccine target

A vaccine is the holy grail of malaria control. Alan Cowman, of Melbourne's Walter and Eliza Hall Institute, has discovered proteins that are key to the malaria parasite's virulence, and therefore a potential vaccine target. He's been able to weaken live parasites by manipulating their genes. It's the culmination of over 20 years' research into malaria and won Alan a $50,000 Victoria Prize.

Mundane passion anchors $20 billion industry

An engineer has credited a passion for the mundane as the driving force behind his geotechnical solutions that have influenced nearly all the oil and gas developments in north-west Western Australia.

The industry is expanding rapidly to meet the demand for natural gas in the growing Asian economies. Mark Randolph has contributed to anchoring the essential infrastructure as the industry moves offshore and into deep waters. He provides the analysis and design of piled foundations and solutions for offshore foundations, anchoring systems and pipelines.

"I make no apology for being first and foremost an engineer working at the very applied end of science," he says. "And it's primarily for my passion to see the rather mundane—and I might say the rather grubby—world of soil mechanics and geotechnical engineering elevated in this way."

Mark won the 2013 Western Australian Scientist of the Year. He is based at the Centre for Offshore Foundation Systems at the University of Western Australia.

Starch to save young lives

A fibre may help save millions of children in developing countries who die or who are left malnourished from diarrhoea each year.

Graeme Young, AM, of Flinders University, is leading a global project that will test his theory that resistant starch increases zinc absorption in the body.

"Zinc tablets are currently given in response to an acute attack of diarrhoea but only a minority follow the recommended course of tablets. There may be other complementary ways to ensure we better correct nutritional deficits in zinc and so better deal with the problem," Graeme says.

Graeme was named the 2013 South Australian Scientist of the Year for this research, as well as for his work on Australia's national bowel cancer screening program.

He is professor of global gastrointestinal health at Flinders University, and at the time of the award was director of the Flinders Centre for Innovation in Cancer.

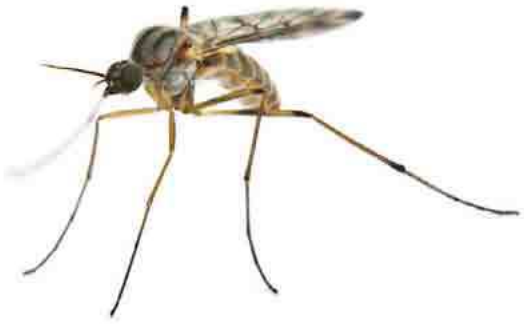
Putting off joint replacement

Advanced medical imaging has allowed Tasmanian scientists to trial new therapies for osteoarthritis and to potentially delay the need for joint-replacement surgery.

Graeme Jones and his team from the Menzies Research Institute used dual-energy X-ray absorptiometry to see what was happening to a joint's internal structure as osteoarthritis developed, allowing them to spot changes long before a conventional X-ray could.

With a better understanding of the early factors that lead to the disease, the team has been able to test new therapies to target bone swelling, cartilage regeneration and inflammation, among others.

Graeme's research has earned him the Tasmanian Scientist of the Year Award.



PHOTOS: THIS PAGE: JAMESON CELL TECHNOLOGY IS USED IN OVER 300 MINERAL PROCESSING PLANTS WORLDWIDE, CREDIT: UNIVERSITY OF NEWCASTLE; RESISTANT STARCH IN THE DIET MAY PROTECT MILLIONS OF CHILDREN IN DEVELOPING COUNTRIES FROM DIARRHOEA; OPPOSITE PAGE: AUSTRALIA'S ANZAC FRIGATES ARE BEING UPGRADED WITH IAN CROSER'S RADAR TECHNOLOGY TO DEFEND THEMSELVES AGAINST MISSILES, CREDIT: AUSTRALIAN DEFENCE DEPARTMENT; MARK RANDOLPH IS PROVIDING ENGINEERING SOLUTIONS TO SUPPORT OFFSHORE OIL RIGS.

The 2013 ATSE Clunies Ross Award Winners follow in the footsteps of past winners such as Ian Frazer, inventor of the cervical cancer vaccine; Nobel laureate Barry Marshall, who discovered the bacteria that causes stomach ulcers; Fiona Wood, inventor of spray-on skin; and Martin Green and Stuart Wenham, international leaders in silicon cell technology.

Under every ocean, crossing every mountain

Our connected lives depend on reliable global communication carried by a net of undersea glass cables.

And in those cables are technologies developed by Simon Poole and Steven Frisken. Simon and Steven are Australia's most successful commercialisers of new technologies that have shaped the internet worldwide including key components of the Australia's National Broadband Network.

Their products, including undersea communication systems, are sold to all the major telecommunications equipment manufacturers in Europe, the United States, Japan and China, and have generated exports worth hundreds of millions of dollars from their factory in Sydney.

The tests we need to eradicate TB

Anthony Radford, James Rothel, Paul Wood and Stephen Jones have fundamentally changed the way tuberculosis is diagnosed around the world, by inventing and commercialising revolutionary technology that is greatly assisting in global TB control in both humans and cattle.

They played a role in successfully eradicating bovine TB in Australia.

Protecting ships

"Floating targets", said a junior defence minister of Australia's Anzac frigates back in 1998. This year one of those frigates, HMAS Perth, intercepted a missile travelling three times the speed of sound in trials off Hawaii. The frigate now has one of the best small warship defence systems in the world.

At the heart of the system is a digital phased-array radar technology developed by Ian Croser of CEA Technologies. The system looks 60 km in all directions and can track multiple threats.

In 1982 Croser and his colleague David Gaul left the Australian Navy and founded CEA Technologies. Now employing over 270 employees, it is Australia's largest majority owned defence company, making advanced radar and communications solutions for civil and military applications.

Academy recognition

The Australian Academy of Science recognised five individuals for their career achievements in 2013.

The search for dark matter was kicked off by Ken Freeman's discovery that there wasn't enough matter to hold spiral galaxies like ours together.

Medicines based on metals like copper, chromium and ruthenium could come out of chemist Peter Andrew Lay's study of how they work on diabetes, cancer and inflammation.

Big data can help solve problems in public health, biological systems and the natural environment using statistical computer algorithms developed by Matthew Paul Wand.

Symmetries found by mathematician Cheryl Elisabeth Praeger lie at the heart of permutations and real-world systems, from large agricultural experiments to the patterns of weaving.

Geologists use Roger Powell's models and computer software to determine how metamorphic rocks were formed in the intense heat beneath the Earth's crust.

A further eight researchers under the age of 40 received the Academy's early-career awards.

Microbes in soil may determine the development of plants that grow in them, and Ulrike Mathesius's work understanding how they do this could open possibilities for improving crops.

How blood cells form, how they develop into cancer and how both these processes are affected by cancer treatments are being illuminated by Benjamin Kile's research.

An improved understanding of the genetics of mitochondria, the tiny powerhouses inside our cells, is enabling Aleksandra Filipovska to create new drugs to treat diseases caused when they malfunction.

Convincing evidence of the link between worsening heatwaves in Australia and greenhouse gas emissions has been provided by Lisa Alexander.

A new understanding of the movement of tectonic plates and the formation of mountains, volcanoes and deep-sea trenches has come from Wouter Schellart's theories of the dynamics of the solid Earth.

Techniques developed by Aurore Delaigle for analysing data and finding the patterns and relations behind them are being applied to complex investigations in biology and physics, such as the search for gravitational waves.

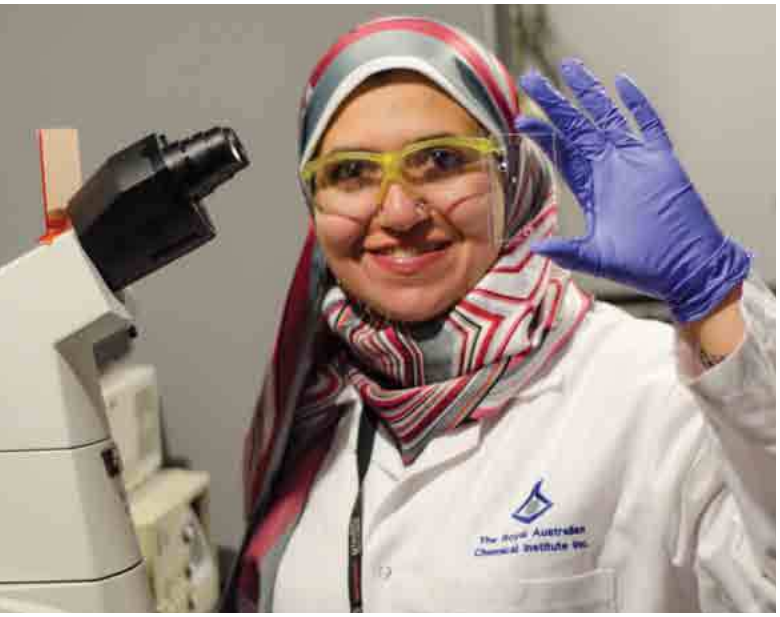
A map of galaxies created using Australian telescopes has enabled Christopher Adam Blake to determine the strength and smoothness of dark energy, the mysterious force that's causing the accelerating expansion of the Universe.

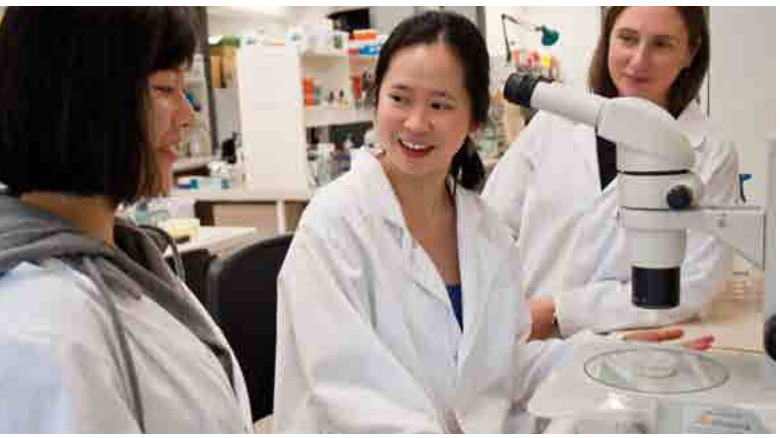
Polymers and nanomaterials assembled by chemist Sébastien Perrier with what he calls 'molecular lego' are being used for sustainable new materials for paint, personal care and health and medicine.

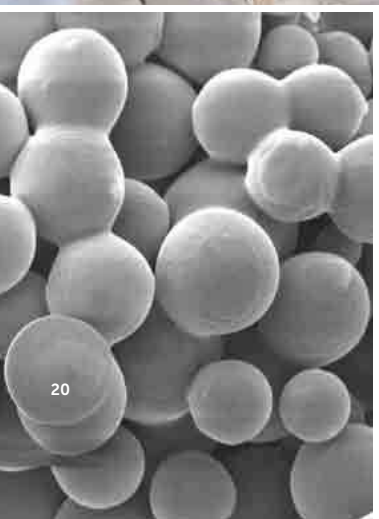
A full list of AAS awards is at www.science.org.au/awards

freshscience

Each year we identify early-career scientists with a discovery and bring them to Melbourne for a communication boot camp. Here are some of their stories. For more information go to freshscience.org.au







Two tiny fossils link Australian marsupials to South America and Africa

Two tiny fossils are prompting an overhaul of theories about marsupial evolution after they revealed unexpected links to South America—and possibly Africa.

The two fragments, found at the Tingamarra site in south-eastern Queensland, are set to overturn the theory that there was a single migration from the part of the Gondwana 'supercontinent' that became South America to the part that became Australia.

One of the fossils is a 55 million-year-old ankle bone from a mouse-sized marsupial previously known only from South America. The second is a tooth, which derives from a formerly unknown species that shows similarities to fossils found in South America and North Africa.

"The origins of Australian marsupials suddenly got a lot more complicated," says palaeontologist Robin Beck, of the University of New South Wales.

Electric fishes spark safer power line technology

Inspired by electric fishes, Melbourne researchers have invented and patented a way of detecting and locating potential electrical faults along large stretches of power line.

Early detection could help prevent major discharges that lead to sparking and blackouts, which might reduce the risks of bushfires caused by electric sparking, says Alexe Bojovschi, of RMIT University.

The patented wireless sensing technology, which Alexe and his colleagues have commercialised, is already being used by local electricity companies and has the potential to be used globally.

Worms reveal link between dementia gene and ageing

The discovery of a link between a specific gene and ageing in a tiny transparent worm could reveal valuable lessons for the treatment of Alzheimer's disease.

Yee Lian Chew, a PhD student at Sydney University, found that the tau gene, which is also present in humans, codes for a protein that affects the worm's life span—low levels of the protein hastens age-related changes in the worm's brain and shortens its life.

Yet high levels of the proteins are also thought to be associated with cognitive impairment in people with dementia.

"It needs to be a balance," says Yee Lian, whose research could provide a stepping stone towards improving diagnostic tools and treatments for Alzheimer's sufferers.

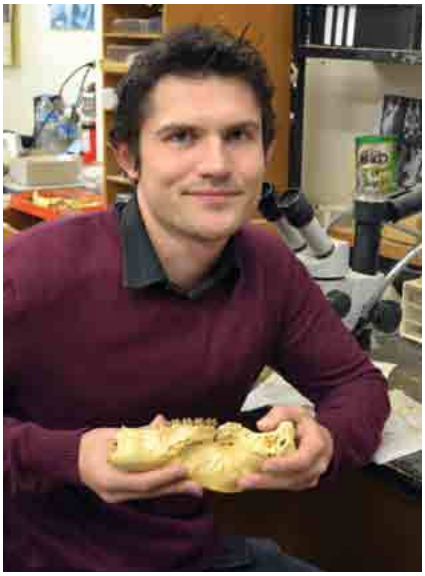
The fastest sperm may not be best

Sydney sea squirts show that there's more to fertilisation, and maybe IVF, than we thought.

Angela Crean, of the University of New South Wales, discovered that sea squirt eggs fertilised within minutes by speedy sperm, and their subsequent larvae, had low survival rates. The strongest, fittest, longest-lived sea squirts grew from eggs fertilised by sperm that swam for about an hour before reaching the egg.

"This is surprising because it suggests that a sperm's influence on offspring extends beyond just the DNA it carries," says Angela.

As part of her research Angela studied larvae produced from mass sea squirt spawnings in Sydney Harbour. She hopes her research will contribute to improving assisted reproduction methods in humans.





Using genes to counter rust

An international study led by a Queensland scientist has found a way to better safeguard an important food crop—and the world's beer supply.

University of Queensland geneticist Lee Hickey and his team successfully identified a gene, Rph20, which protects barley against the serious leaf rust disease. They then developed a diagnostic DNA marker to determine the presence of the gene.

Lee's discovery will enable selective breeding of barley to provide genetic protection to the disease—resulting in much lower chemical use and reduced crop losses.

"To date, there have been no reports of a strain of leaf rust that has overcome the Rph20 resistance," he says. "Thus we hope this gene will continue to provide long-lasting protection around the world."

Building on mud: when can we start?

A Queensland engineer can now predict how long it takes for reclaimed land to become suitable for development, potentially saving millions of dollars in building costs and avoiding structural failures.

Julie Lovisa, of James Cook University, has created a mathematical model to predict when reclaimed land is solid enough to build on, allowing for greater accuracy in construction timelines.

"We need to be as accurate as possible in our predictions—if we're out by just one per cent, this can mean the difference between starting construction in two or 20 years," she says.

How ankles can save footballers' knees

Knee injuries in Australian footballers could be dramatically reduced if physiotherapists paid more attention to ankles, according to a mechanical engineer from the University of Melbourne.

Hossein Mokhtarzadeh has developed mathematical models of the muscles that protect the anterior cruciate ligament, which is often damaged in football knee injuries and costs the game millions of dollars each year.

"We are improving our mathematical models to predict and screen athletes who are at a high risk of injury while they play," says Hossein, who is working with the Carlton Football Club.

He says the study will help develop new neuromuscular training methods and the design of bracing systems, which would benefit coaches, physiotherapists, human movement scientists and athletes.

Monitoring drugs at home, not the hospital

Personalised medication may become a reality with a tiny Tasmanian invention that accurately measures a drug's concentration in the blood in just three minutes.

Aliaa Shallan, a PhD student at the University of Tasmania, developed the mechanism at the heart of a hand-held device that could let millions of people test their own blood at home for just a few dollars per test.

Billions of people take prescription drugs every day but the optimum dose for each person can vary greatly. Personalised medicine accommodates these differences by tailoring the dose to the drug level in the blood.

"It is devices like this that will … dramatically change the quality of life of billions of people around the world," Aliaa says.

Aussie algae fuel green oil hope

Newly trialled native algae could provide real hope of developing commercially viable biofuels.

Evan Stephens and his team at the University of Queensland, in collaboration with Germany's Bielefeld University and Karlsruhe Institute of Technology, have identified fast-growing and hardy microscopic algae that could be farmed to produce a renewable fuel that would help steer Australia away from petroleum oil dependency.

Despite the claims of some in the biofuel industry, commercially viable fuels from algae have not yet been developed.

"While we know that we can produce algae oil that is even higher quality than standard petroleum sources, we are working to increase the efficiency of production so that we can compete with fossil fuels dollar for dollar," Evan says.

Sticky ear mystery solved

Perth researchers are trialling a treatment that could end the sleepless nights that families face when ear infections strike and won't go away.

Ruth Thornton and her research team at the University of Western Australia have discovered that sticky nets of DNA hide the bacteria in the ears of kids with recurrent middle-ear infections, where they evade antibiotic treatment by creating impenetrable slimy biofilms.

Their research could reduce the need for antibiotics and surgery, and help tackle hearing loss in Indigenous communities.

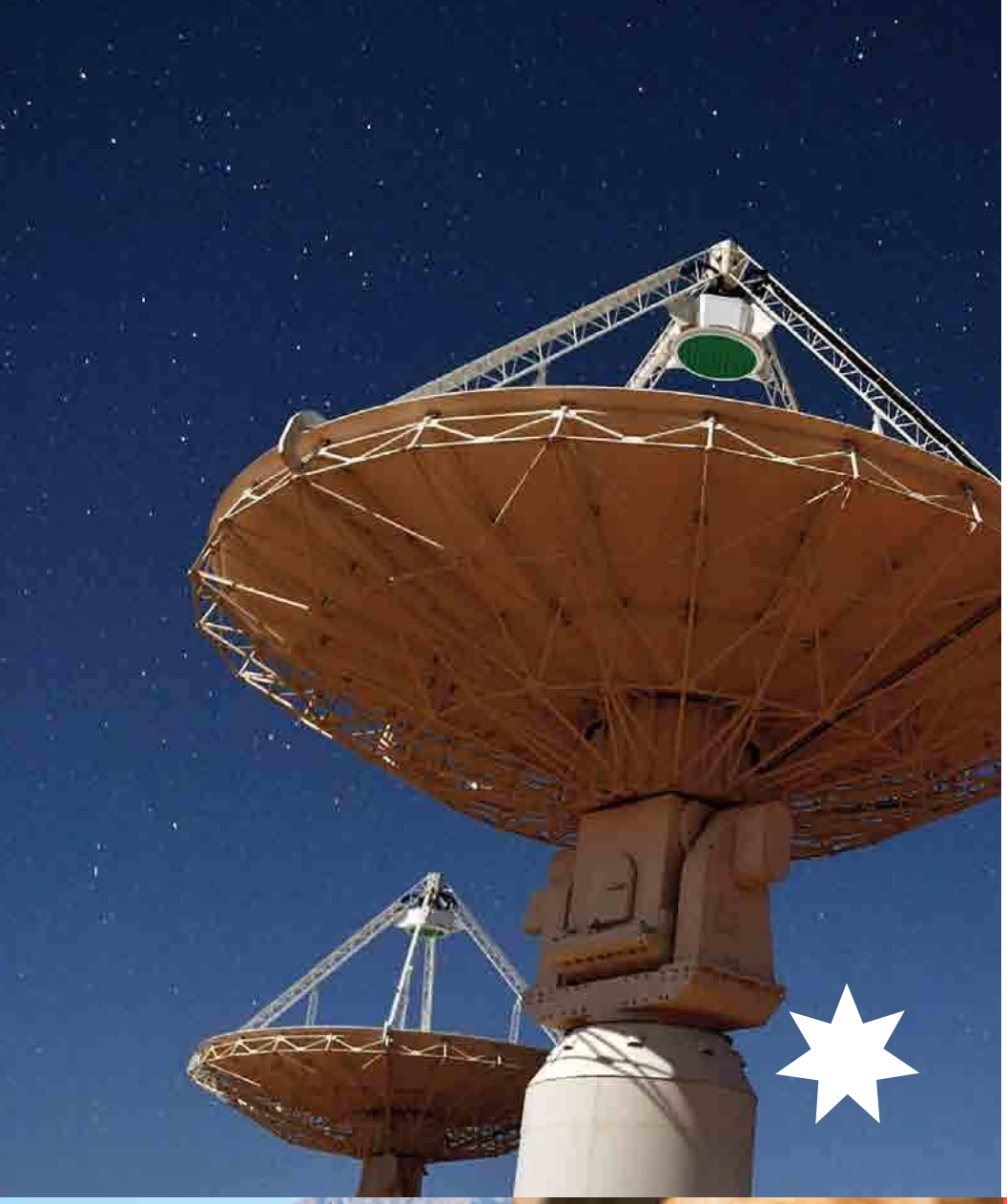
Mixing drugs and alcohol for better asthma inhalers

Asthma inhalers could soon become much more effective thanks to a clever new way of making the particles they deliver.

Monash University lecturer Meng Wai Woo and his team have developed a method of making ultrafine particles, which will make drug delivery to the lungs much more consistent and efficient.

Current puffer designs and the typical size ranges of particles mean that much of the medication propelled into a patient's throat remains there—only a fraction reaches the lungs.

PHOTOS: OPPOSITE PAGE: CLOCKWISE FROM TOP: LEE HICKEY, CREDIT: LEE HICKEY; EVAN STEPHENS IS WORKING TO PRODUCE BIOFUEL FROM NATIVE ALGAE, CREDIT: EVAN STEPHENS, UQ/FRESH SCIENCE; MENG WAI WOO IS DELIVERING ASTHMA MEDICATION WITH FINE PARTICLES, CREDIT: MENG WAI WOO; YEE LIAN CHEW (CENTRE), CREDIT: ESTELLE LLAMOSAS, UNIVERSITY OF SYDNEY; ALIAA SHALLAN, CREDIT: AEMI ABDUL KEYON, UTAS. THIS PAGE: ROBIN BECK, CREDIT: UNSW; ALEXE BOJOVSCHI, CREDIT: ALEXE BOJOVSCHI, RMIT; RIGHT (TOP): JULIE LOVISA IS IMPROVING LAND RECLAMATION PLANNING, CREDIT: PORT OF BRISBANE; (BELOW LEFT): ANGELA CREAN'S RESEARCH ON SEA SQUIRTS MAY ASSIST IVF METHODS, CREDIT: UNSW; (BELOW RIGHT) RUTH THORNTON, CREDIT: EBONY FROST, TELETHON KIDS INSTITUTE. INSET: HOSSEIN MOKHTARZADEH'S MATHEMATICAL MODELS MAY REDUCE KNEE INJURIES IN AFL FOOTBALLERS, CREDIT: HOSSEIN MOKHTARZADEH, UNIVERSITY OF MELBOURNE.



Australian Science 2014...Stories of Australian Science 2014...Stories of Australian Science 2014...Stories of Australian Science 2014...Stories of Australian Science 2014

2014 Stories of Australian Science

Published by

Science in Public Pty Ltd
82 Hudsons Road
(PO Box 2076)
Spotswood Victoria 3015 Australia

niall@scienceinpublic.com.au

Find us online at
www.scienceinpublic.com.au/stories
and register for regular updates on
Australian science.

Science in Public @scienceinpublic