The Royal Society OF VICTORIA
Promoting science since 1854

Inspiring Australia Victoria

SCIENCE VICTORIA

AUGUST 2023

PLASTICS AND INFERTILITY

The Plastic Plague on Reproductive Health

pg 15

SCIENCE AND POLICY

Bridging the Gap Between Two Worlds

pg 21

NATIONAL SCIENCE WEEK 2023 IS HERE!

Join Events Around Victoria in August

pg 30

PLUS

The Plastisphere
From the Archives
Snapshots of STEMM

ISSN 2981-8664
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IN THIS ISSUE

SCIENCE VICTORIA

This Edition: Plastics

Since the first plastics were synthesised in the 1800s, a problem has been quietly brewing for the world: what do we do with all the plastic waste? With more than 50% of all plastic ever made having been produced between 2004-2023, the scale of the problem is increasing at an exponential rate. In this edition, we look at some of the problems micro- and macro-plastics are causing, and what needs to be done both now and llong-term to solve these problems that we have created.

On the Cover: Microplastics are pieces of plastic <5 mm in length, and they are now found almost everywhere: in the air, the water, the soil, all levels of the food chain, in human breast milk, on the fresh Antarctic snow, and even in Arctic and Antarctic sea ice.

Please note that the submission deadline for content to be included in the September 2023 "Victoria's Flora" edition of *Science Victoria* is **5pm, Friday 18th of August 2023.**

NATIONAL SCIENCE WEEK IS HERE!

Mike Flattley
CEO, The Royal Society of Victoria

The scope and application of science is as infinite as the universe, so it is with no small effort that our national network condenses Australia's annual celebration into a single week each year.

This year, National Science Week runs from the 12th to the 20th of August, featuring in-person and online events right across the State. Science is everywhere and in everything that we do, informing every field of human activity and endeavour.

Without the partnership and support of an engaged network of colleagues and science champions stepping up to make it happen, it simply wouldn't. So I'd like to record my particular thanks to our partners at Museums Victoria and Science Gallery Melbourne for working fast in fluid conditions to make our launch and major program "Social Animals" something quite special, and to the community organisations, public libraries and institutions who have dreamed up a diverse and creative array of special events for our fellow Victorians to enjoy, learn and grow from in the weeks ahead. It's going to be amazing! Details are provided in the Inspiring Victoria section of this month's edition.

This edition's theme of "Plastics" offers a cautionary foil to the celebratory context of Science Week. The last century's rapid development of a petrochemical industry has unlocked incredible new tools and capacities for the human species, enabling quality products to be mass produced at low cost to transform every aspect of our lives. Indeed, the low cost of plastics has driven their high rate of disposability, which has brought our natural systems - environmental (collective) and physiological (personal) - to yet another crisis point.

There appears to be no corner of our planet, around us or within us, devoid of post-consumer plastic waste. As with so many other scientific achievements (*Oppenheimer* is in theatres now), with plastics we have opened another Pandora's Box to release all the ills of the world - not because we should, but because we could, and that species-level decision has had such a transformative impact on soils, waterways, and entire ecosystems that it has now entered the geologic record to define an entirely new epoch, the Anthropocene.

Pandora's Box is obviously made of plastic. This devastatingly useful material has been wrought by science, a testament to the crucial role of human agency in tool making. Science is not a decision; it is a tool, a process, a method. As with emerging technologies like AI, how we govern this tool is a principled matter that we must confront together as informed individuals to ensure the Earth remains a safe and accommodating home for the only known life in our universe.

And yes, Pandora's Plastic Box also contains hope; so as the unprincipled use of science got us into this mess, it's incumbent upon us all to explore how it might get us out again. Our articles this month explore something of the problem, and something of the solution; the landscape is vast, and we invite you to explore it.

Mike Flattley
CEO, The Royal Society of Victoria

SCIENCE VICTORIA, VOLUME 3, NUMBER 7, AUGUST 2023

The Monthly Publication of the Royal Society Victoria - Established 1854 for the promotion and advancement of science. Supported by the Inspiring Victoria Program

Acknowledgement of Country:
The Royal Society of Victoria acknowledges the many First Peoples of our continent, their vast history and connection to the lands and waters within and beyond the State of Victoria, and the valuable cultural and scientific knowledge held by the Elders to care for Country. We acknowledge our headquarters are located on Wurundjeri land, never ceded, and convey our respect to Elders past and present. The RSV welcomes all First Nations people, and seeks to support and celebrate their continued contributions to scientific knowledge.

THE PROBLEM WITH PLASTIC

Rob Gell AM MRSV
President, The Royal Society of Victoria

The real problem with plastic is that it's too good at what it does! Benefits include its toughness, high strength-to-weight ratio, water resistance, insulation value, and its low cost. Unfortunately, it's now everywhere, even in human breast milk.[1]

Plastic waste is an enormous global problem. Its manufacture and management produces more greenhouse emissions than global shipping – almost double the aviation sector.[2] It's made from fossil oil or gas and only a fraction of what is produced is recycled. Contamination from plastics and microplastics is now at crisis level as it is found in all ecosystems, from ocean and coast to mountains, cities, and rural areas.[3]

Unfortunately Australians aren't good performers in the use of plastic. Australians consume more single-use plastic than they do in all but one country![5] The Australian Marine Conservation Society and World Wide Fund For Nature (WWF, formerly World Wildlife Fund) Australia have calculated that we're generating more single-use plastic waste per person than any other country except Singapore, that 16 million tonnes of emissions are generated from the plastic Australians use annually and that amount is set to double by 2050.

Recycling won't be enough. We now need to set limits on plastic consumption. The WWF has called for a global ban on 'harmful and unnecessary' single-use plastic items such as vapes, cutlery, and cosmetic microplastics, ahead of key UN plastic pollution treaty talks.[6]

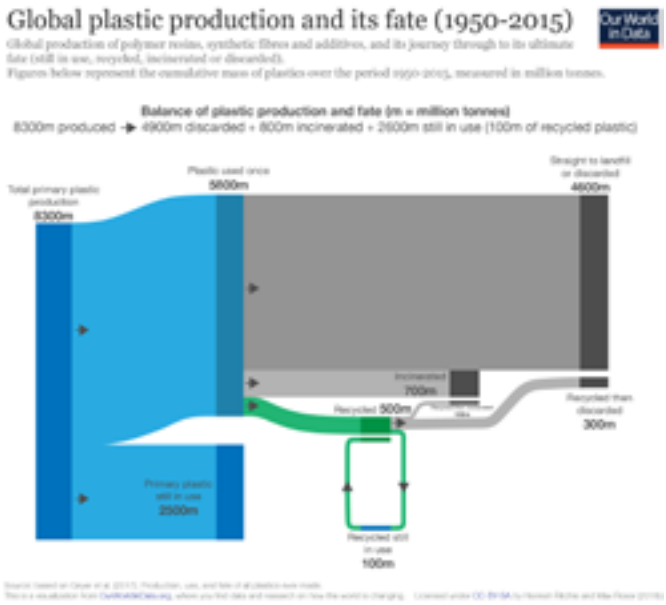
Australia has joined what is perhaps the most important global agreement since the Paris Agreement: to end plastic pollution by 2040. It was signed by the Minister for the Environment and Water Tanya Plibersek in November 2022 together with the New Plastics Economy Global Commitment.[7] The legally binding treaty aims to improve recycling, clean up the world's plastic waste with curbs on plastics production, and potentially a ban on single-use plastics.

Plastic pollution isn't a new problem. In 1991, the Plastics Industry Association of Australia produced Managing Plastics for a Better Environment: An Executive Guide as a resource for companies wishing to improve their environmental performance.

The guide talks about environmental audits, clear company aims and objectives, principles for environmental management, better company structures and systems and monitoring of procedures.

"There will be a responsibility, in all present operations and in all plans for future projects, to take fully into account environmental impacts, and not just the irritating detail but as an integral part of any company operations, equally important as any other …"[8]

Henderson Island in the Pitcairn group is considered the most polluted island in the world, as Pacific currents dump masses of plastic and rubbish along its beaches.[4]



The fate of plastic produced globally from 1950 to 2015 in million metric tons. Source: Our World in Data (CC-BY-SA)

Clearly not everyone received a copy and the suggestion that 'companies which choose to ignore their environmental obligations will become increasingly uncompetitive and together with their directors should expect to be the subject of litigation in relation to environmental damage caused by their activities and products' hasn't stood the test of time.

Thirty-two years on, what have we learned? Is this a company responsibility? Clearly legislation has been inadequate, industry has paid 'lip service' to (limited) community concerns, producer responsibility has been inadequate, there has been no focus on resources recovery, our environment has suffered the impacts of escalating throughput of plastic waste at all levels of the supply chain and consumer behaviour has done little to arrest the problem of plastic in our environment.

We need to stop kicking the plastic football down the road and invest in advanced technologies to manage waste plastic as a resource. To date in Australia, we have only seen politically generated downcycling solutions using waste plastic in waste-to-energy projects, or in road base. The material is kept out of the waste stream, but these are not circular economy solutions. Whether this is a good solution remains a subject of debate.

Other developments have been on 'biodegradable' and compostable plastics, although these require industrial systems, and frequently only break down into smaller 'microplastics' that do not break down. Bioplastics from plants, animals, or micro-organisms may be of future use.

Chemical recycling can involve replacing today's commercial polymers with chemical alternatives that can be depolymerised using specific reactions.

Pyrolysis technologies aim to break down plastic waste into its basic building blocks through thermal decomposition, allowing them to be reused in the production of new plastic products. Char, oil, and syngas are useful products of the process although sometimes yields are low and toxic paraffins and aromatics may be produced as side products. Pyrolysis is now being employed by a Melbourne company that hopes to open a commercial facility this year.

As an example, Canadian company Klean Industries is a specialist in pyrolysis technologies used in processing end-of-life plastics and is evaluating permitting and feedstock opportunities in Australia, the Philippines, and Singapore.[9] Klean claims to be able to convert waste plastic into hydrogen, liquid fuels, chemical and clean energy with the benefits far outweighing downcycling. Klean Industries technology has already been used extensively in Asia, where it has successfully converted waste plastic into high-quality low-sulphur diesel fuel. Critics argue that by converting waste to petroleum feedstock, it will only perpetuate a dependence on fossil fuels.[10] Some studies suggest creating pyrolysis oil from used plastic is worse for the climate producing higher greenhouse gas emissions than using conventional drilling to extract crude from the ground.
Perhaps there are some valuable technical solutions not far away – even in Victoria!

You'll find a number of valuable articles on plastic in this edition. I'm sure you'll agree with me that our editor Scott Reddiex has developed Science Victoria into a very valuable publication. Please share it with your colleagues and friends and draw their attention to membership of the RSV - personal or for their organisation. Please email me at **president@rsv.org.au** with your thoughts on the use of waste plastic, new technologies you may be aware of and how we can promote them.

Rob Gell
President, The Royal Society of Victoria

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SNAPSHOTS OF STEMM

Images from everyday science.

Botanist Dr Meg Hirst lands on a remote section of the Alpine National Park, Victoria, to survey flora for the BushBlitz program in the Australian Alps, 2023.

Photograph: Royal Botanic Gardens Victoria.

SNAPSHOTS OF STEMM

"Cardboard City Crafters" at Scienceworks constructed buildings, trees, crowns, and other objects with cardboard and a cardboard construction toolkit. Over the course of the day, the space was filled with creative constructions and cardboard everywhere.

Photograph: Catriona Nguyen-Robertson/Museums Victoria.

SNAPSHOTS OF STEMM

Dr Jemma Cripps, Wildlife Ecologist checking traps as part of a study with the Arthur Rylah Institute.

Photograph: Jess Miller/Arthur Rylah Institute.

NEW RSV MEMBERS

INDIVIDUAL MEMBERS

Professor Matt Kuperholz
Artificial Intelligence Scientist, The University of Melbourne

Miss Anneke Cook
Student, Methodist Ladies College

Mr Matthew Cook
Student, Rossbourne School

Professor Antonio Patti
Professor of Chemistry, Monash University

Dr David Stapleton
Innovator, Patched Up

AFFILIATES

Members of the Royal Society of Victoria are advised of our governing Council's intention to accept Land Covenantors Victoria as an Affiliate of the Royal Society of Victoria, in accordance with Rule 8 (4) of our governing rules (**rsv.org.au/rules-bylaws/**).

ABOUT LAND COVENANTORS VICTORIA (LCV):

Victoria greatly benefits from the biodiversity on private land. Some threatened plants and animals are found only – or largely – on private land, and the archaeological, landscape, and recreational values of this land enrich us all. LCV represents landholders who have placed covenants on their land to conserve biodiversity, increase habitat and preserve these landscapes for future generations. We learn from our Traditional Owners how to steward this land.

With the support of the Rendere Trust and EcoGipps in 2021, a group of 'first wave' land covenanters formed Land Covenantors Victoria as an Incorporated Association to bring the >1,500 land-holders with conservation covenants in Victoria together to share knowledge, support each other, and advocate for them.

Further information on LCV's aims and activities is available from **landcovenantors.org.au**.

LAND COVENANTORS VICTORIA

BECOME A MEMBER OF THE RSV

The Royal Society of Victoria is the State's oldest scientific society, a part of Australia's intellectual life since 1854. We bring together an independent community of science practitioners, educators, industrialists, and enthusiasts to promote an understanding and utilisation of scientific knowledge for the benefit of the state of Victoria.

$40/YEAR

Student Membership

For students enrolled full-time at a recognised Victorian education and/or research institution (proof of current, full-time enrolment required for Student Membership commencement/renewal)

$120/YEAR

Full Membership

Open to all adults (18+) with an interest in science! A current membership of the Royal Society of Victorian entitles the use of the professional postnominal 'MRSV.' Those elected as Fellows of the Society are entitled to the postnominal 'FRSV.'

$1000/YEAR

Organisational Membership

For organisations to claim membership of the RSV. Provides a method for general sponsorship of the RSV's programs, along with discounted rates for access to RSV facilities throughout the year.

The Royal Society OF VICTORIA
Promoting science since 1854

To join the Royal Society of Victoria please go to **rsv.org.au/how-to-join**. You can also choose to support science in Victoria by completing the donation form in this edition or visiting **donorbox.org/royal-society-victoria**

75-86% of all plastic waste found in the Great Pacific Garbage Patch (GPGP) has been identified as coming from offshore fishing activity.

Source: Lebreton, L., et al. (2022). Industrialised fishing nations largely contribute to floating plastic pollution in the North Pacific subtropical gyre. *Scientific Reports*, 12(1), 12666. doi.org/10.1038/s41598-022-16529-0

NATIONAL SCIENCE WEEK 2023

There are many interesting and engaging events being held around Victoria this month as part of National Science Week.

Some of the events being held this month by Inspiring Victoria initiative partners, National Science Week grant recipients, and seed grant recipients can be found in the Inspiring Victoria section (**Page 28**).

To see all events happening around Australia, visit **scienceweek.net.au**

RSV YOUNG SCIENTIST RESEARCH PRIZES 2023

As part of its promotion and advancement of STEMM in Victoria, the Royal Society of Victoria fosters and recognises the excellence in Victoria's early career researchers through the annual RSV Young Scientist Research Prizes.

These four prestigious competitive prizes are open to Victorian students in their final year of doctoral candidature, in all areas of the **Biomedical & Health Sciences**, **Biological Sciences (Non-human)**, **Earth Sciences**, and **Physical Sciences**.

Judges of the RSV Young Scientist Research Prizes have forged distinguished careers within these areas, and will select eight PhD finalists (two from each category) to present their work to a general audience.

Following the presentation from finalists, judges will determine the winner from each category.

Join us in-person or online to hear about the latest science from our emerging scientists, and to support and celebrate the achievements of Victoria's upcoming high achievers.

This event will be simulcast online with the support of the Inspiring Victoria program (**inspiringvictoria.org.au**).

Please note the date of this event has changed from the 17th of August to the 28th of September.

RSV YOUNG SCIENTIST RESEARCH PRIZES

Date/Time:
Thursday, 28 September 2023, 6pm - 9pm

Price:
Free

Location:
The Royal Society of Victoria
Wurundjeri Country
8 La Trobe Street, Melbourne
(Simulcast on Zoom and Youtube)

Reserve your spot for in-person or online attendance at:
rsv.org.au/events/ysrp-2023/

UNDERSTANDING CLIMATE CHANGE: ALL THE NATURAL AND HUMAN CAUSES

Presented by Professor Raymond Cas, Monash University

Although anthropogenic (human made), post-industrial revolution greenhouse gases are commonly attributed to be the cause of climate change, there are in fact many factors that contribute to climate change and global warming, past and present.

Geological evidence indicates that global climate has changed throughout Earth history, including contributions from long-term heat loss from the Earth to the atmosphere, Earth's orbital behaviour, and a number of plate tectonic processes. In addition, atmospheric and oceanographic dynamics and the way that tectonic plate and continental movements control these, also play a part in changing global climate. Volcanism constantly releases gases to the atmosphere producing contradictory effects on atmospheric temperature and in some cases, global climate.

And then, there is the elephant in the room – human generated greenhouse gases. How does their effect stack up against all the previous causes? All will be revealed!

ABOUT THE SPEAKER

Professor Raymond Cas is an Emeritus Professor in Volcanology in the School of Earth, Atmosphere and Environment at Monash University, where he taught, undertook research and was Head of the former School of Geosciences. He is well known internationally in the volcanology research community for his research on volcanic eruption processes and volcanic hazards on modern volcanoes around the world, as well as having been President of the International Association for Volcanology (IAVCEI, 2011-2015). Ray also undertook research in collaboration with the mining industry to develop a better understanding of mineral ore deposits such as gold, silver, copper, lead, zinc, nickel and diamonds hosted in ancient volcanic rock successions. He is the (co-) author of over 150 research papers, one book on volcanology, with another currently in production and has supervised over 50 postgraduate students.

Ray is still undertaking research at a relaxed pace as an Emeritus Professor.

UNDERSTANDING CLIMATE CHANGE: ALL THE NATURAL AND HUMAN CAUSES

Date/Time:
Thursday, 7 September 2023, 6pm

Price:
In-Person: $10 (non-RSV members)/$5 (RSV members)
Online: $5 (non-RSV members)/Free for RSV members

Location:
The Royal Society of Victoria
Wurundjeri Country
8 La Trobe Street, Melbourne
(Simulcast on Zoom and Youtube)

Reserve your spot at:
rsv.org.au/events/understanding-climate-change/

GIRLS IN PHYSICS BREAKFASTS PROGRAM

The Royal Society of Victoria is an auspice for the Laby Foundation to fund the Girls in Physics Breakfasts program, organised by the Vicphysics Teachers' Network, and run across Victoria each year.

The Girls in Physics Breakfasts Program invites girls in years 10-12 to share a table with two or three women who either have a career in physics or engineering, or who are at university studying in either of these areas.

Over breakfast, the students are encouraged to ask questions about what the physicists and engineers do in their roles, how they found their job, what studying at university is like, and more. This is followed by a speaker, who talks about her research and her career.

After a Q&A session, there are a few careers-based activities, which are of value to students and guests alike to finish the event.

The Girls in Physics Breakfasts Program started in 2016, and already this year there have been two Breakfasts held in central Melbourne and Mildura. The remaining breakfasts for 2023 are listed below.

Vicphysics is always seeking more women to attend a breakfast. The more women who attend, the more school bookings we can take.

All breakfasts run from 7:30 am until 10:00 am, and are free for all guests.

Reserve your spot at:
vicphysics.org/events/girls/breakfast/

2nd August, Geelong
Speaker: A/Prof Elizabeth Hinde, the University of Melbourne.
Topic: Glow in the dark – Using fluorescence to observe DNA in a living cell.

11th August, Wodonga
Speaker: Emma Dyce, Medical radiation physicist.
Topic: Treating skin cancer with radiotherapy.

16th August, Traralgon
Speaker: Prof Rachel Webster, the University of Melbourne.
Topic: Geothermal: vast energy reserves beneath our feet

25th August, Ballarat
Speaker: Dr Taissa Danilovich, Monash University.
Topic: Nanomagnets: New materials to address biomedical and technological problems.

1st September, Bendigo
Speaker: Dr Amanda Karakas, Monash University.
Topic: Stars as chemical element factories.

UPCOMING RSV EVENTS

The RSV hosts many STEMM-related events, public lectures, and meetings throughout the year. These are predominantly held at the RSV Building at 8 Latrobe St, Melbourne (unless otherwise indicated), and simulcast online via YouTube/ Facebook Live. Our public lectures comprise the "Scientists in Focus" component of the Inspiring Victoria program in 2023.

7 SEPTEMBER

SEMINAR: UNDERSTANDING CLIMATE CHANGE - ALL THE NATURAL AND HUMAN CAUSES

Prof Raymond Cas will explore the geological evidence of global climate change throughout Earth's history, including contributions from long-term heat loss to the atmosphere, orbital behaviour, atmospheric and oceanographic dynamics, and a number of plate tectonic processes, including volcanism. How do their effects stack up against human influences?

Join us in person or online, **Thursday 7 September**, from 6pm.

For more information, visit
rsv.org.au/events/understanding-climate-change/

28 SEPTEMBER

RSV YOUNG SCIENTIST RESEARCH PRIZES

Finalists of the RSV's annual Young Scientist Research Prizes will present their work and the winners announced at this event in September.

For more information, visit
rsv.org.au/awards-and-prizes/young-scientist-research-prizes/

12 OCTOBER

RSV + AATE MEETING & PUBLIC LECTURE

Joint Meeting and Public Lecture with the Australian Academy of Technology and Engineering

23 NOVEMBER

RSV PHILLIP LAW POSTDOCTORAL AWARD LECTURE

The winner of the RSV's Phillip Law Postdoctoral Award will present their work to a special meeting of the RSV at a public lecture scheduled for the evening of Thursday, **23 November 2023**. This will be professionally filmed and shared online.

For more information, visit
rsv.org.au/awards-and-prizes/phillip-law-award/

7 DECEMBER

RSV RESEARCH MEDALLIST LECTURE

The winner of the annual RSV Medal for Excellence in Scientific Research will present a lecture to RSV members and guests on the evening of **Thursday, 7th December 2023**, at which the Medal will be presented.

For more information visit:
rsv.org.au/awards-and-prizes/research-medal/

Plastic waste in the Himalayas (Gorakshep, Khumjung, Nepal).

RACS VICTORIAN ANNUAL SCIENTIFIC RESEARCH AWARDS

Applications for The Royal Australasian College of Surgeons' Victorian Annual Scientific Research Awards are now open.

The awards are an opportunity for young doctors, medical students, and International Medical Graduates (IMGs) from across Victoria to present scientific research as oral and poster presentations in front of a panel of Surgeons.

This year's research theme is *Efficiency in the Age of Sustainability*.

Applications close **13 August 2023**.

For more information, and to apply, visit **surgeons.org/en/about-racs/racs-offices/victoria/scientific-research-awards-oral-and-poster-presentations**

ELEVATE: BOOSTING WOMEN IN STEM

Applications for the Australian Academy of Technological Sciences & Engineering's Elevate: Boosting Women in STEM Program commencing in 2024 are currently open.

The Elevate: Boosting Women in STEM program will award up to 500 undergraduate and postgraduate scholarships to women in STEM. The program aims to address gender inequities in STEM through fostering more women-led industry-academia collaborations in applied research and business, growing professional skills of women in STEM, and propelling women into leadership.

The Elevate program provides:
- A scholarship
- Access to events and networking
- Mentoring
- Ongoing support during scholars' university studies

Applicants are required to meet three eligibility criteria:
- Identify as a woman or non-binary person
- Be enrolling as a domestic student
- Be planning to undertake a STEM degree or higher studies to improve business acumen at an Australian university, commencing in 2024

Applications for the 2024 Elevate program close at 5:00pm (AEST) **31 August 2023**.

For more information, including application and eligibility guidelines, visit **atse.org.au/career-pathways/elevate/**

Samantha Zaman, PhD student, University of Melbourne and the ARC Centre of Excellence in Exciton Science (Source: Exciton Science)

THE PLASTIC PLAGUE ON REPRODUCTIVE HEALTH

By Rachael Rogers, PhD Candidate in Reproductive Biology, and Professor Andrew Pask, Professor in Genetics, both at the University of Melbourne.

We all know that plastics are bad for the environment, but did you also know that they could be affecting our fertility and reproductive health too?

Infertility is a major issue in society today, with the World Health Organisation stating that one in six people will experience infertility in their lifetime.[1] On top of this, we have also seen a dramatic decrease in both male sperm count and female conception rates by almost 50% in the past 50 years.[2,3] This decrease in fertility can be largely attributed to our increasing exposure to chemicals in our environment known as endocrine disrupting chemicals (EDCs).

EDCs are defined as any agent that can block or interfere with the natural hormones within our body, like oestrogen and testosterone. Hormones are essential for our reproductive health and development, and any disruption to normal hormonal signalling can impact our fertility and increase our risk of developing reproductive disorders. EDCs are ubiquitous in our environment; they're present in herbicides, pesticides, cosmetics, and pharmaceuticals, however, they're most commonly found in plastics.

Plastics are made of plasticisers, and these plasticisers are often EDCs. Two of the most common plasticisers are BPA and phthalates. BPA is an estrogenic EDC, meaning it can bind to and activate the oestrogen receptor, thereby leading to unwanted oestrogen signalling. BPA is added to a variety of products including food and drink containers, baby bottles, plastic wrap and it is even used in the lining of receipts. Under certain conditions, such as heat and UV, BPA can leach from these products leading to high human exposure. BPA is so ubiquitous in our environment that studies have shown that 92% of the US population have detectable levels of BPA present in their urine.[4] This is alarming as BPA is a known reproductive toxicant.

An Italian study investigating the effects of EDCs on female reproductive health found that women experiencing infertility have significantly higher levels of BPA present in their blood compared to fertile women.[5] BPA exposure has also been associated with polycystic ovary syndrome (PCOS), one of the most common female reproductive disorders affecting 5-15% of women.[6] Women with PCOS have been shown to have significantly higher levels of BPA in their blood compared to women without PCOS.[7] Animal studies have also highlighted the negative reproductive effects of BPA, with prenatal exposure significantly impacting the timing of puberty and reducing fertility in female mice.[8]

The other common class of plasticisers are phthalates, with the most ubiquitous being diethylhexyl phthalate (DEHP). DEHP is commonly added to soft plastics to increase their flexibility,

and, like BPA, is added to food and drink containers, as well as medical tubing and equipment (such as IV bags). This is an issue for premature babies, who are often connected to medical tubing for monitoring and support, as they can have exposures as high as 100 times the recommended upper limit of DEHP.[9] DEHP exposure impacts both male and female reproduction, with accelerated puberty and impaired sperm motility (movement) having been observed in mice.[10,11]

Although exposure to EDCs is harmful during all stages of life, it is particularly harmful during key developmental stages, such as pre- and neo- natal life. Activation or inhibition of normal hormonal pathways as the reproductive system develops can predispose individuals to disease later in life. Key genetic and epigenetic programming also occurs at this time, setting up germ cells (which go on to form the sperm and eggs) for the next generation. Any alterations to gene expression caused by EDC exposure, can hence not only contribute to reproductive diseases within a person, but also cause changes to their germ cells, impacting future generations.

Our research group at the University of Melbourne investigates the effects of EDCs on reproductive development. The specific EDC we research is called diethylstilbestrol (DES), a synthetic oestrogen drug that was prescribed to pregnant women between 1940-1970 in the hopes of preventing miscarriage and premature labour. Although DES is not found in plastics, we use it as a model to understand the impacts of other estrogenic EDCs present in the environment.

Our research found that exposing a pregnant mouse with DES doesn't just affect the fertility in her offspring - reduced fertility continues to impact her descendants into the second and third generation in both males and females. This is alarming as the second and third generation developed in a normal hormonal environment and did not have a direct foetal exposure to DES. We also saw that the female descendants went through puberty significantly earlier than control females, and male descendants had significantly increased rates of hypospadias, a misplacement of the urethral opening on the penis. Hypospadias is the most common human congenital birth defect and its incidence has doubled in the past 50 years, now impacting 1 in every 125 live male births.[12] These results highlight the long-lasting effects of EDCs and suggest that what we are exposed to today may not only affect ourselves, but future generations to come.

Avoiding plastics and exposure to EDCs is almost impossible today, and a radical change to the way plastics are used is needed. Change can come about through consumer choice, such as choosing food and water which comes in metal or glass packaging over those made of plastic. Knowing which products to avoid and choosing those that don't use EDC plastics can help, but this is hard due to the prevalence of these products in almost everything we use. Ultimately, we need more studies defining the impacts of EDCs on reproductive health to underpin global reform and stringent policies on the use of these chemicals in our environment.

—

Rachael Rogers is a PhD Candidate in Reproductive Biology, working under the supervision of Professor Andrew Pask (Professor in Genetics) at the University of Melbourne.

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Diethylstilbestrol (DES) - sold under the name desPLEX - is a synthetic oestrogen drug that was previously prescribed for preventing miscarriage and early labour. Rachael usesDES as a model to understand the impacts of chemicals in plastic (such as BPA) that disrupt the function of our natural hormones.

THE PLASTISPHERE - AN OCEANIC COSMOS OF ITS OWN

By Priya Mohandoss MRSV

To say that there is an enormous amount of plastic in our oceans is an understatement. A 2023 study has estimated that there are more than 170 trillion plastic particles, with a combined weight of over 2.33 million tonnes, currently floating in the world's oceans.[1]

WHAT IS THE PLASTISPHERE?

Present on plastic marine debris is a thin biofilm - a layer of organisms that coats the plastic.[2] It is called the "plastisphere" and is regarded as separate to nearby seawater and other natural objects. Although the plastisphere has been around for as long as plastic has been entering the environment, it was marine microbiologist Linda Amaral-Zettler at the Royal Netherlands Institute for Sea Research who first coined the term in 2010. It was then published in a 2013 study that determined the presence of this plastic-colonising microbial community.[3]

WHERE IS IT FOUND?

Today, plastic marine debris is found in all five major ocean gyres, and in the Southern Ocean.[4] Gyres are areas of large circulating ocean currents that act like a vortex, causing floating waste to be gently drawn into their core. Although the plastisphere was first encountered in the North Atlantic Subtropical Gyre,[3] it is now believed to be present across all of these stretches of seawater.

WHAT LIVES THERE?

The plastisphere acts similarly to other ecosystems, however it is an anthropogenic region where mostly microbes such as bacteria and algae call their abode. It is also sometimes referred to as an artificial "manmade reef". The presence of these different types of organisms allows for processes such as photosynthesis to occur. In addition, various fungi have also been found on plastic marine debris, and are likely to be the key to carbon processing,[5] where it is possible for fungi to absorb carbon and direct it to higher levels in the food chain instead of it being sent back as carbon dioxide into the atmosphere. Other sea animals that are able to drift on, or attach themselves to, scraps of plastic also occupy this region, ranging from crabs to molluscs to jellyfish.

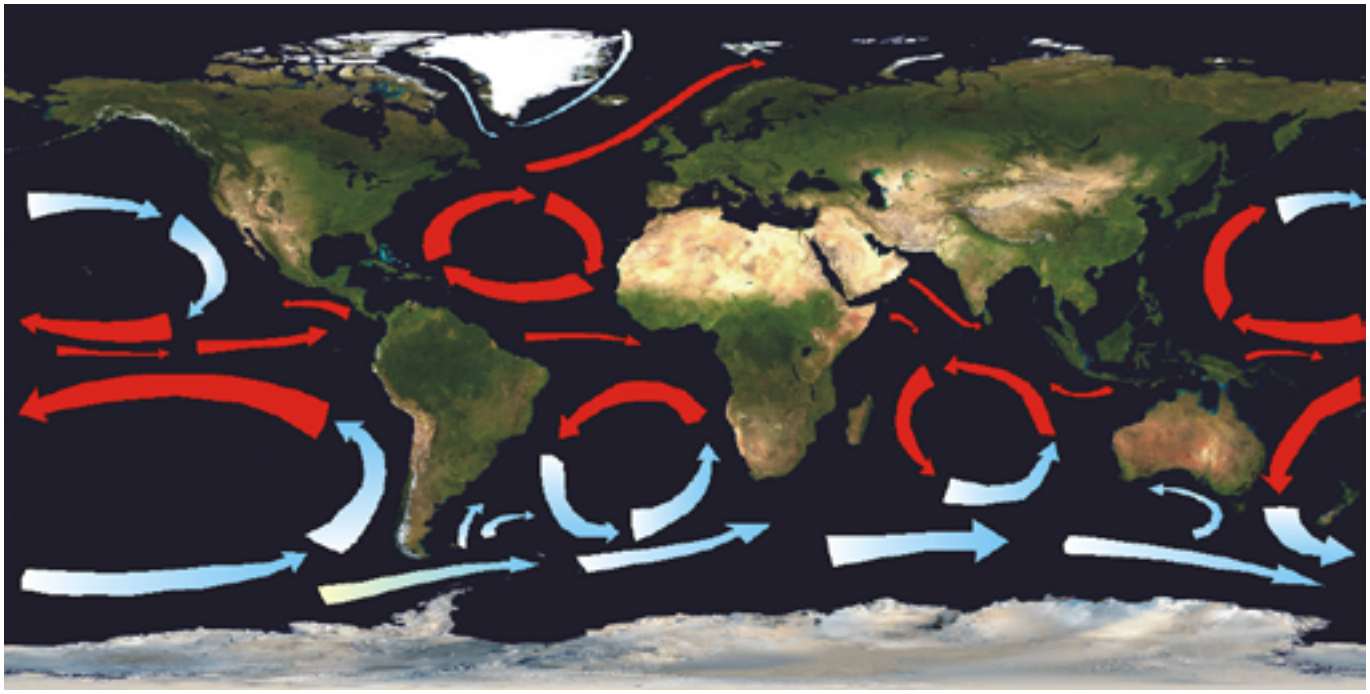
HOW IS PLASTIC CLASSIFIED?

Depending on its size, plastic can either be microplastic or macroplastic. Microplastics are any type of plastic that is 5mm or less in diameter, such as resin pellets found mostly in shampoo and gels. Macroplastics are made up of large items such as single-use plastic bags, food packaging and straws. However, it is important to note that macroplastics can also become secondary sources of microplastics if they break down. Most of the plastic marine debris curling swirling around the ocean are microplastics. Along with other major environmental concerns, such as overfishing, they too are now seen as an ocean stressor.

HOW DOES TIME HAVE AN IMPACT?

Organisms found on the plastisphere can survive for much longer than those that live on natural materials such as feathers or driftwood. This is due to plastic having a slow decay rate. However, this can also be a setback as it means that these organisms are able to sail across much of the ocean. As a consequence, this creates a vehicle of passage for harmful algal-bloom-forming

Locations of oceanic gyres (CC BY-SA 3.0)



algae and potential pathogenic bacteria such as vibrios species. Furthermore, the interaction of microbes with plastics and their associated persistent organic pollutants, additives and metals,[6] can result in the production of toxins. Therefore, any external source that comes into contact may become affected, creating instability to those marine networks already present and disrupting the ocean food web.

WHAT AREAS STILL NEED TO BE CONSIDERED?

Although the plastisphere may be seen as an emerging threat, it is also somewhat of an enigma. As a consequence, there is a need to unravel its mysteries in order to gain a sense of awareness of its interactions with ocean life and all that it embraces.

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LIFE IN PLASTIC: THE PLASTIC DWELLERS AND EATERS THAT COULD HELP CLEAN UP OUR WASTE

By Dr Catriona Nguyen-Robertson MRSV

When life gives you plastic, you live with it, you break it down and you… eat it. At least that is what some organisms have evolved to do.

Plastic is one of the most enduring materials we humans have created. Millions of tonnes of plastic pollution (including microplastics) pervade the planet from the deepest oceans to the top of Mount Everest.[1,2] It can take hundreds of years for plastic to degrade alone, but nature may already have answers to our problem in the form of organisms that consume plastic. While for these forms of life, it might not be as "fantastic" as Aqua's 1997 song may have led us to believe, it is certainly incredible how some organisms have adapted to utilise it – and these plastic-eaters may provide us with potential ways to clean up our mess.

A HOME MADE OF PLASTIC

For some organisms, plastic debris literally provides a life raft. Around 8 to 10 million metric tons of plastic end up in the ocean each year, and some of it provides a home to entire biological communities.[3] Scientists first discovered that microplastics are home to life in 1972, when two studies reported microorganisms living on plastic retrieved from the North Atlantic Ocean.[4,5] A further study dubbed the diverse and complex community of microbes found on ocean plastic, the "Plastisphere". Since then, numerous studies have observed microbes and animals that are using plastic rafts to colonise the open ocean. The broad range of surface textures available on the garbage form ideal habitats for many species, from single-celled microbes and algae to barnacles and insects. In addition, plastic provides a place for coastal species to breed (e.g. lay eggs) and expand their populations into the open ocean when they would otherwise be confined to shore.

The bad news is that plastic dwellers could make ocean plastics more attractive as food for animals further up the food chain. The more creatures that reside on plastics, the harder it is for other animals to distinguish between plastic waste and food. Animals that accidentally eat plastic often suffer, as the ingested plastic fills their stomachs, reducing how much they eat, or larger pieces can also clog their gastrointestinal tract. Furthermore, marine species can hitch a ride on these plastic rafts for long periods of time. Following the 2011 earthquake and tsunami in Japan, scientists expected floating trash to wash up on other shores. What they did not expect was for Japanese mussels, barnacles, and sea squirts – 289 species in total – to survive a six-year trek across the Pacific Ocean.[6] This raises concern that invasive species are able to travel from one shore to another, potentially invading new habitats and impacting local ecosystems.

The good news is that some plastic inhabitants may weigh down the plastic, decreasing plastic pollution level at the sea surface, where major environmental impacts occur. For example, diatoms – a silica-forming algae – that grows on ocean plastics in large numbers can weigh down its plastic home, causing tiny pieces of plastic debris to sink to the bottom of the ocean. Bacteria such as *Pseudomonas* can also grow as a biofilm on microplastics – a cluster of microbes that adhere to the surface – thereby weighing them down. Not only is this potentially beneficial in open water, but also in wastewater treatment, as our current processes do not sufficiently eliminate plastic waste and biofilms can be grown on plastic pieces to weigh them down to be sifted out. In addition, researchers have also seen colonies of microbes within the Plastisphere that seem to be "eating plastics" and thereby providing a form of biodegradation.

Plastic-eating fungi used for biodegradation as part of the Gene Technology Access Centre (GTAC)'s 'Is fungus the future?' program run for National Science Week 2019. (Photograph: Catriona Nguyen-Robertson).

THE PLASTIC EATERS

Plastics take anywhere from 20 to 500 years to decompose into microscopic particles, depending on the material and structure. This is simply not fast enough, nor is it good enough - we produce plastics faster than they break down, and most molecules of plastic that we have ever produced are still present in the environment.

Many plastics are hard to degrade and recycle, but with plastic having become an abundant "resource" in the environment, many organisms have evolved to eat it by adapting enzymes over time to break the sturdy bonds within plastic compounds. In 2021, a study of ocean and soil samples from around the world revealed that the plastic-degrading potential of microbes correlates with pollution trends: more plastic-degrading enzymes were present in habitats with more pollution.[7]

Many of the organisms that we now know to degrade plastic were discovered accidentally. The first bacteria discovered to break down and metabolise plastic was found in a Japanese bottle-recycling facility.[8] The new species, Ideonella sakaiensis, breaks down PET to create basic building blocks for its growth. PET is one of the most common plastics and does not readily break down in the environment. All the wet wipes, water bottles, or product packs made of PET that head to landfill will stick around for centuries – unless hungry *I.sakaiensis* are around. Moreover, a Biohm biotech engineer also discovered a plastic-eating fungus after she realised that one of the fungi had eaten its way through the plastic seal of the jar she was growing it in.[9] Some animals can even eat through plastic - granted, for many like the common *Zophobas morio* 'superworm' that can digest polystyrene (e.g. foam), it is thanks to bacteria in their gut.[10] Wax worms were the first insect discovered to digest plastic themselves. Again, this was an accidental discovery: a scientist who was also an amateur beekeeper cleaned out her hives infested with wax worms and dumped the larvae in a plastic bag, only to find that the larvae saliva could break down polyethylene within hours allowing them to escape.[11]

Organisms that degrade plastics typically only have the capability to digest one plastic type, over time, and under certain conditions. Furthermore, plastic is, unsurprisingly, not the most exciting food option (albeit, to some like the superworm, it does provide enough nutrition to make them gain weight).[9] There is, however, great potential for scientists to work together with these organisms and their enzymes.

The 2021 study of plastic-eaters from around the world identified a total of 30,000 enzymes that degrade 10 types of plastics.[7] While we may not see industrial "composts" in the near future with a community of organisms breaking down our plastic waste, we could engineer some of these enzymes using biotechnology. Scientists tweaked the enzyme from *I.sakaiensis* that digests PET, and inadvertently created a version of the enzyme that was even better at breaking down plastic bottles than the bacteria. After many iterations, they have produced a "super enzyme" that can break the tough chemical bonds in PET 10,000 times more efficiently.[12] Plus, when the building blocks generated by the enzyme are used to make new PET for plastic bottles, the bottles are just as strong as those made from conventional plastics. A research team at the University of Edinburgh have even engineered *E.coli* bacteria to turn a molecule derived from PET into the flavour molecule, vanillin (with the same structure as that obtained from a vanilla bean).[13] Perhaps we could be recycling - and even eating derivatives - of plastic too.

Biodegradation is a plausible route toward sustainable management of the millions of tons of plastic waste that have accumulated in terrestrial and marine environments. With 30,000 enzymes in the environment to degrade plastic, there are plenty to use to our advantage. By breaking down microplastics into smaller components, we can recycle them into new products, such as 3D-printed plastic materials or recycled plastic bottles. When scientists work together with the many organisms that have evolved to live with our waste, we make a great team.

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"Superworms" eating their way through polystyrene foam as part of Science Gallery Melbourne's Disposable exhibition in 2019. (Photograph: Tilly Boleyn/Science Gallery Melbourne).

LISTENING TO CASSANDRA: BRIDGING THE GAP BETWEEN SCIENCE AND POLICY

By Dr Don Williams

"I think the people in this country have had enough of experts…saying that they know what is best and getting it consistently wrong."

Michael Gove, British Secretary of State for Justice, June 2016

Science has transformed humanity's understanding of the universe. Science-based revolutions in industry, communications, medicine, and transportation have brought about astonishing improvements in life expectancy and affluence. However, these achievements are inevitably accompanied by dark shadows, typified by anthropogenic climate change and the development of weapons capable of obliterating civilization.

The transformative power of science suggests it should play a fundamental role in developing public policy. This would ensure science informs debates about issues such as sustainable energy production, ecosystem protection, and genetic modification of food.

However, both the literature and everyday experience indicate that using scientific knowledge to inform policy debates is not straightforward. This article examines how to better integrate science and policy development.

SCIENCE AND POLICY: TWO WORLDS?

Public policy can be defined as 'a set of decisions by governments and other political actors to influence, change, or frame a problem or issue that has been recognized as in the political realm…'.[1] Given the significant technical content of many important issues, it seems self-evident that science should be a bedrock component of policy debates.

However, the literature identifies inherent barriers to seamlessly linking science and policy. A consistent theme is that science and policy are fundamentally different activities. Scientists seek to remove 'values' (such as value-judgements, personal beliefs, and biases) as they search for empirically based, generalisable findings. In contrast, policy development must balance competing values, and consider the broader socio-political context.[2,3,4] For the policymaker, 'evidence' also includes values, ideologies, moral judgements, and anecdotes. Values-related assessments are inherent to policy development, as are judgements about the politically feasibility of different courses of action.[4]

While this 'Two Worlds' model highlights fundamental intellectual differences between science and policy, there are also practical barriers that inhibit effective communication between the two fields:

Attitude to Uncertainty - Science sees uncertainty as an inherent part of advancing knowledge. In contrast, policymakers are uncomfortable with uncertainty, as it can be fatal for policy proposals.

The Policy Cycle: Myth Versus Reality - Real policymaking is a far more diffuse, erratic process than is suggested by the traditional policy cycle model. Attempts to inform policy based on this model are bound to produce sub-optimal results.

Information Saturation - Scientific advice can be crowded out by the avalanche of information, of varied credibility, that is available in the twenty-first century. Thus, scientific knowledge may have to compete with other types of 'information' (social media content, anecdotes, claims from lobbyists, etc.) to establish its pre-eminence.

Incompatible Timeframes - Policymakers operate to tight timelines, often with weekly and daily deadlines. These timeframes can generate spontaneous requests for advice, which do not align well with the more measured process used to create scientific knowledge. This is compounded by the rapid churn of elected officials.[4]

The varied capacity of science to influence policy is illustrated by the following two cases. They show that the success of science-based policy development is unpredictable.

TWO CONTRASTING CASES

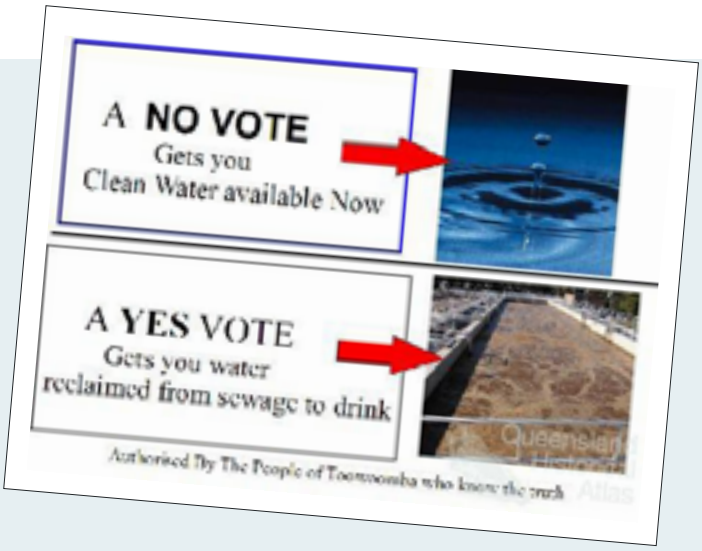
CASE 1 - SCIENCE OVERSHADOWED: TOOWOOMBA RECYCLED WATER PROJECT

Toowoomba (QLD) suffered water shortages during the early-century Millennium Drought. The city's water demand was estimated to exceed the safe yield from its dams by 1998, with demand thereafter progressively exceeding reliable supply.[5]

In response, the City of Toowoomba (responsible for water supply) released a Water Futures Initiative in 2005. The Initiative's most important element was 'indirect reuse' of treated wastewater for water supply. This envisaged sending treated wastewater to a multi-stage water processing plant, transferring the water produced by the plant to a dam, and further treatment of the water before it was used to supply Toowoomba.[6]

This scheme was based on sound science:

- Water would pass through seven well-proven pollutant removal steps before reuse.[6]
- A multi-year testing program would be overseen by the CSIRO prior to recycled water use commencing.[5]
- Australian Drinking Water Guidelines provided scientific benchmarks for safe drinking water quality.[6]
- The National Water Commission, the then peak technical water policy adviser to Australian governments, assessed and approved the scheme.[5,7]



Above: Images used in the Anti-Recycled Water Campaign, Toowoomba

At the policy level, solid political support appeared to have been locked in. The Initiative was launched with the support of all Toowoomba councillors, local Queensland MPs and the Queensland Premier, and the local Federal MP.[7] However, this support fractured when concerted local opposition appeared. A number of politicians withdrew their support, so the project was 'no longer about water and was all about politics and vested interests', and was consequently abandoned. [5,7] A technically sound proposal was not adopted as public policy following a noisy political debate.

The Initiative's failure reflects several of the issues previously highlighted:

- The differing worldviews of science and policy are shown by the willingness of some politicians to cease supporting the Initiative when community opposition appeared, suggesting a failure to adhere to the intellectually rigorous, evidence-based approach championed by science.
- The policy process was unpredictable compared with the 'policy cycle' model.
- The Initiative's opponents 'said what they liked and maligned anyone who had an opposing view', leading to scientific information having to compete with unreliable sources of information.[5]

This case confirms that efforts to translate science into public policy may be confronted by emotive language and arguments, and turbulent policy processes. Fortunately, more encouraging examples can be identified.

CASE 2 - SUCCESS FOR SCIENCE: FLUORIDATING MELBOURNE'S WATER SUPPLY

Adjusting fluoride concentrations in drinking water to suitable levels (0.6 to 1.1 mg/L) reduces tooth decay and the associated health impacts. There are no reliable links between fluoridation and any health problems in Australia.[8]

In Australia, fluoridation started at Beaconsfield (TAS) in 1953, with Bacchus Marsh being the first Victorian town to receive fluoridated water (1962). However, Melbourne's water was not fluoridated until 1977. The debate preceding the introduction of fluoridation in Melbourne included three distinct stages:

1953-1961: Although the Public Health Commission supported fluoridation, the Victorian government refused to adopt a formal policy, in the face of opposition from sections of the community and media. The issues of 'mass medication' and the rights of individuals to control their own bodies were fiercely debated.

1962-1972: The government continued its failure to adopt a fluoridation policy, reflecting internal disagreements and continued opposition by anti-fluoridation groups. Sporadic efforts by local governments to introduce fluoridation were frustrated by the absence of a state-level policy framework.

1973 - 1977: With the advent of a new Ministry, the government moved decisively to support fluoridation. Legislation was passed that empowered the Public Health Commission to direct water utilities to implement fluoridation. The Commission issued this direction for Melbourne's water supply, which was fluoridated in 1977.[9]

The protracted debate that preceded fluoridation of Melbourne's water supply shows that:

- Policy debates go beyond rational assessment of scientific information and include contested value judgements.
- Opponents of fluoridation resorted to emotive language and arguments.
- Traditional policy development models do not reflect the unpredictable nature of highly politicised policy discussions.[9]
- These points are consistent with the barriers to translating science into policy identified in section (2) and by the Toowoomba case. However, Melbourne's eventual adoption of fluoridation demonstrates that these barriers are not always insurmountable: persistent, brave advocacy may ultimately achieve policy reforms.

Having examined barriers to linking science and policy, we next examine ways to mitigate them.

RECONCILING THE TWO WORLDS

The published literature on how scientists can improve their capacity to influence policy outcomes is extensive. A large-scale review in 2019 by Oliver and Cairney of advice to academics about how to influence policy identified hundreds of relevant articles, some dating back to the 1950s.[10] The review included a thematic analysis to identify 'key tips' for scientists to influence policy, which produced these recommendations:

- Do high-quality research.
- Communicate well: make your research relevant and readable.
- Understand policy processes, policymaking context, and key actors.
- Be 'accessible' to policymakers, engage routinely, flexibly, and humbly.

- Decide if you want to be an 'issue advocate' or 'honest broker'.
- Build relationships (and ground rules) with policymakers.
- Be 'entrepreneurial' or find someone who is.
- Reflect continuously: should you engage, do you want to, and is it working?

Fortunately, these recommendations mirror sound professional practices that most scientists seeking to influence policymaking will be aware of, such as effective communication, building sound relationships with policymakers, understanding the policy context, and reflecting on how to improve policy inputs.

An encouraging sign that governments are now recognising the need for science to inform policy is the adoption of the Commonwealth Water Act (2007), following intense negotiations between the Australian government and the governments of Victoria, New South Wales, Queensland, South Australia, and the Australian Capital Territory. The Water Act includes a central role for science. It addresses the overallocation of water to irrigated farming in the Murray Darling Basin at the expense of other purposes, including providing environmental flows to support riverine ecosystems. The Act requires that environmental needs are prioritised ahead of other water uses, and the best available science is used to determine environmental water allocations.[11]

In accordance with the Act, hydrological modelling was used to set quantitative environmental water recovery targets for the Basin.[11] Using scientific knowledge to set specific targets, as opposed to relying on general statements of policy intent, has similarly been recommended to drive the adoption of sustainable urban water management practices, such as conservation and recycling.[12]

While the adequacy of the Basin environmental recovery targets has been the subject of considerable controversy, the Water Act's explicit acknowledgement of the importance of science in environmental management is a very welcome development.

CONCLUSIONS

The case for science to inform policymaking is overwhelming, but there are inherent differences between the two endeavours. Fortunately, most scientists are familiar with the communications, relationship-building and self-reflection practices recommended to improve the capacity of science to inform policy development. Scientists seeking to influence public policy should recognise and implement these procedures. Scientists should also identify specific targets that can be incorporated in policies, such as the quantitative greenhouse gas reduction targets adopted by the Victorian and Australian governments.[13,14]

Sustained advocacy may also result in scientific advice being adopted after a lengthy interval, if political re-alignments provide a more receptive environment for policy change.

The ability to build sound relations with policymakers, communicate well and maintain advocacy for specific policy outcomes over prolonged periods is well suited to institutions, as well as individual scientists. A relevant example was the Victorian government's creation of the office of Lead Scientist in 2013, to build links between industry, academia, and government.[15] The Royal Society of Victoria's focus on linking science and policy outcomes is, of course, also very positive. The Society is well placed to further strengthen relationships with policymakers in Victoria and communicate scientific knowledge to them.

Dr Don Williams worked for 30 years in the water quality management, wastewater regulation and water efficiency fields. Don then completed a PhD examining how planning laws influence the adoption of sustainable urban water practices. Don has a long-standing interest in how scientific knowledge influences public policy.

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The Nuggets penguin rookery, Macquarie Island. Photograph taken 1911-1914 by Australasian Antarctic Expedition photographer Frank Hurley. Source: State Library of New South Wales (Public Domain)

1973

A PENGUIN IN HAND IS WORTH TWO IN THE STRATA

By Scott Reddiex MRSV

In the 1974 *Proceedings of the Royal Society of Victoria*, zoologists Allan R. McEvey (National Museum of Victoria) and Wilhelmus J. M. Vestjens (CSIRO) published the article "*Fossil Penguin Bones from Macquarie Island, Southern Ocean*".

At roughly the same size as the City of Greater Dandenong, Macquarie Island is a small (128km²), isolated island in the Southern Ocean, roughly halfway between New Zealand and Antarctica. McEvey and Vestjens visited the island in 1957 and 1962 respectively, with the latter spending 12 months on the island as Resident Biologist, during which time he would have enjoyed an average [2.4] hours of sunshine each day.[1]

In their paper, they described the fossil beds of Finch Creek and Bauer Bay, the fossilised skeletons of Royal Penguins (*Eudyptes chrysolophus schlegeli Finsch*) and King Penguins (*Aptenodytes patagonica Miller*) found at these sites over the preceding 63 years, and compared them to more recent remains. Their comparisons showed that there was '*no consistent evidence of evolutionary change*', which implied '*a fair degree of morphological stability in this species as represented on Macquarie Island during the last 6,000 years*'.

Macquarie Island was first documented in 1810 by the sealer Captain Frederick Hasselborough, although his sighting of a shipwreck on the island suggests he was possibly not the first arrival. The island was subsequently rapidly exploited for its large seal, penguin, and seabird populations, with 193,000 fur seals slaughtered for their skins over the next decade, and 8,400 tonnes of oil produced from elephant seals between 1810 and 1919.[2,3]

From 1933, Macquarie Island was protected as a wildlife sanctuary,[4] however the already introduced species of rats, mice, rabbits, cats, and wekas continued to decimate the native fauna. After decades of pest-control attempts, the island was finally declared to be pest-free in 2014, although some introduced species of bird and flora remain.[5,6,7]

In addition to its current designation as a Tasmanian State Reserve, in 1997 Macquarie Island was also made a UNESCO World Heritage Site, due to its unique feature of being '*the only place on earth where rocks from the earth's mantle (6 km below the ocean floor) are being actively exposed above sea-level*'.[8]

From:
Proceedings of the Royal Society of Victoria, Vol 86 (New Series), 1974. Fossil Penguin Bones from Macquarie Island, Southern Ocean. By A. R. McEvey and W. J. M. Vestjens, with appendix by Edmund D. Gill.

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Fossilised teeth of *Isurus hastalis* (now classified as *Cosmopolitodus hastalis*), an extinct species of mackerel shark. These specimens, from the Late Miocene period, were examined and described by Chapman and Cudmore. Image: Museums Victoria Collections, Specimen P 161411.3 (CC BY 4.0)

1923

THE FOSSIL RECORD RECORD

By Scott Reddiex MRSV

On the 8th of November 1923, palaeontologists Frederick Chapman and Francis A. Cudmore read part 22 of a series of papers on '*New or Little-known Fossils in the National Museum*' to the RSV. The somewhat unexciting title of this particular instalment ('*Some Cainozoic Fish Remains, with a Revision of the Group*') betrays the otherwise interesting content, which includes the revelation that fossilised Great White Shark (*Carcharodon*) teeth '*found in the Miocene [Epoch] of Eastern and Western Victoria indicate a fish which must have attained a length of nearly a hundred feet [30.5 metres]*'.

In the 56-page article, the pair described their observations of the fossils in detail, with some accompanied by images, and also documented the location of their discovery. The long-running series of papers on fossils in the National Museum (the predecessor to the Melbourne Museum/Museums Victoria) was begun by Chapman in the 1902 edition of the *Proceedings*, and had been published in every edition since, with the ultimate purpose being to assemble all the available pieces of the fossil record in Australia.

In this edition, the authors were also able to state that a number of shark genera – including "*Grey and the Blue Nurse sharks (Carcharias), the Hammerheaded shark (Sphyrna), the Bull-dog shark (Odontaspis), the Blue Pointer sharks (Lanina and Isums) and the Great White shark (Carcharodon)*" – were actually 'three to four million years older' than previously thought. At the time of publishing, they remarked that the '*total number of genera of Cainozoic fishes now known, to the date of this paper, is twenty-eight. The number of species amounts to fifty-nine; of these, there are ten new to science.*'

Both Chapman and Cudmore were accomplished individuals in the field, and influential characters in the history of the RSV. Frederick Chapman held many different positions through his career, including First Commonwealth Palaeontologist, President of the RSV (1929-1930), the Field Naturalists Club of Victoria (1919-1920), and the Microscopical Society of Victoria (1919-1920), and Lecturer at the University of Melbourne (1920-1932).[1]

His co-author, Francis Cudmore, had been an avid collector of fossils in Victoria and Tasmania, amassing a well-documented collection that he later donated to the National Museum of Victoria.[2] He was the Honorary Librarian of the RSV from 1926 to 1953, and the RSV's Cudmore Library is named in his memory.[3]

From:
Proceedings of the Royal Society of Victoria, Vol XXXVI (New Series), 1924. Article IX - New or Little-known Fossils in the National Museum. Part XXVII - Some Cainozoic Fish Remains, with a Revision of the Group. By Frederick Chapman, A.L.S. and Francis A. Cudmore.

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A Meteorite Named Bruce. Bruce Meteorite / Cranbourne No. 1, collected by Alfred Selwyn, Cranbourne, 23 Feb 1862. Image: State Library of Victoria, accession no. H36594 (Public Domain)

1872

BRUCE FROM OUTER SPACE

By Scott Reddiex MRSV

The 1872 *Proceedings of the Royal Society of Victoria* records that on the 10th of June 1872, W. Sydney Gibbons '*read some observations respecting the Cranbourne meteorite, and particulars of an analysis of it made by M. Berthelot.*' Acclaimed French chemist Marcellin Berthelot had analysed a fragment of the meteorite, which had been subsequently published in the previous year in the *Comptes rendus de l'Académie des Sciences* (Proceedings of the French Academy of Sciences).[1]

As part of his analysis, Berthelot paid specific attention to carbonaceous compounds, and reported that it contained '*among other things, fragments of pyrites, and a certain quantity of amorphous carbon*'. He further describes the chemical composition, and contemplates how the compounds may have formed, suggesting *'that the bisulphide of carbon [carbon disulphide], acting on the iron at high temperature, may have been instrumental to the deposition of this graphite.*'

Fragments of the Cranbourne Meteorite were initially found between 1830 and 1860, with the first 'authentic' report about the true nature of the specimens made in 1860 by amateur geologist Edmund G. FitzGibbon. At the time of its discovery, the Cranbourne Meteorite was the largest identified iron meteorite in the world, with a total known weight of 8600kg divided across 13 fragments.[2,3]

The largest of these fragments (Cranbourne 1) is known as 'Bruce', and weighs more than 3550kg. Named after James Bruce, the owner of the land on which it was found, it became the centre of a disagreement between Melbournian and British scientists about where it should be stored, with members of the Royal Society of Victoria and the University of Melbourne petitioning for it to remain in Melbourne. Ultimately, Bruce was traded with London's Natural History Museum for 'Abel' (Cranbourne 2) – the second largest fragment of the Cranbourne Meteorite – where it remains on display to this day.[2,4]

From:
Transactions and Proceedings of the Royal Society of Victoria, Volume X, 1872. Article XLII - Note on the Cranbourne Meteorite, by Sydney Gibbons.

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The **Inspiring Australia strategy** was developed by the Australian Government to increase engagement and interest in the sciences. The **Inspiring Victoria** program is jointly funded by the Australian and Victorian governments with the Royal Society of Victoria.

Inspiring Victoria encourages involvement in STEM through initiatives (such as **National Science Week Victoria**) that are delivered by the RSV's program partners:

- **Public Libraries Victoria**
- **Neighbourhood Houses Victoria**
- **Parliament of Victoria**
- **Museums Victoria**
- **Royal Botanic Gardens Victoria**
- The **Commissioner for Environmental Sustainability**
- **Questacon**
- The **Arthur Rylah Institute for Environmental Research**
- **Zoos Victoria**

NATIONAL SCIENCE WEEK

National Science Week is Australia's annual celebration of science and technology.

Every August, more than 1000 events are held around Australia, delivered by community groups, libraries, museums, universities, schools, research institutions, and science centres.

In Victoria, National Science Week is supported by the Inspiring Victoria initiative, led by the Royal Society of Victoria. In this edition of Science Victoria, we are listing some of the many events supported by Inspiring Victoria partners, and those supported by funding from National Science Week grants or Seed Grants.

2023'S MAJOR PROGRAM: SOCIAL ANIMALS

Social Animals is a series of special events held at Science Gallery Melbourne in collaboration with the Royal Society of Victoria as our State's main program for National Science Week.

There are also other events being hosted by the Inspiring Victoria partner organisations.Young people interviewing academics, a scientific showcase, speed networking, open studio, comedy debates and a banging party; everything we are doing is about bringing us back together to socialise and have fun.

After all, we are Social Animals.

SOCIAL ANIMALS PARTY FOR NATIONAL SCIENCE WEEK

Science Gallery Melbourne

There will be a late night exhibition viewing of Science Gallery Melbourne's latest exhibition DARK MATTERS, some naughty zebras from Born In A Taxi, wild decorations, live music, food, drinks and a toast to celebrate being social animals (i.e. together again).

Date/Time: Wednesday 16 Aug, 6:00PM - 9:00PM
Price: Free
Location: Science Gallery Melbourne (700 Swanston Street, Carlton)

More Information/Registration:
scienceweek.net.au/event/social-animals-party/

KIDS VS SCIENCE

Science Gallery Melbourne

A panel of young people (aged 8-16 years) interview a revolving door of acclaimed scientists about their research and passions. Sparks fly and views collide as the tough questions are asked. Expect fresh conversations, honest encounters and lightbulb moments as the scientists are challenged to dispense with the jargon and explain themselves.

Date/Time: Saturday 12 Aug, 11:30AM - 3:30PM
Price: Free
Location: Science Gallery Melbourne (700 Swanston Street, Carlton)

More Information / Registration:
scienceweek.net.au/event/kids-vs-science/

CITIZEN SCIENCE AND ART COLLIDE WITH MUON OPEN STUDIO

Science Gallery Melbourne

Artist Jon Butt and collaborator Lewis Gittus will create a soundtrack using muon (an elementary particle, similar to the electron) detections, allowing interstellar particles to form musical passages. Visitors can watch the live sound creation, talk with the artists and engage in conversations around the opposing forces of science research and poetic intuition to better comprehend the mysterious and incomprehensible.

Date/Time: Fri 18 Aug - Sat 19 Aug, 11:00AM - 5:00PM
Price: Free
Location: Science Gallery Melbourne (700 Swanston Street, Carlton)

More Information / Registration:
melbourne.sciencegallery.com/events/muon-open-studio

STEMX SPEED NETWORKING: FOR WOMEN AND GENDER DIVERSE HUMANS

Science Gallery Melbourne

The event will bring together people from research, major technology companies, engineering firms, media, and academia with young people from across Melbourne for intimate conversations on their careers.

Date/Time: Tuesday 15 Aug, 5:30PM - 7:00PM
Price: Free
Location: Science Gallery Melbourne (700 Swanston Street, Carlton)

More Information / Registration:
scienceweek.net.au/event/stemx-speed-networking/

SCI FIGHT SCIENCE COMEDY DEBATE: WE SHOULD EMBRACE OUR ANIMAL NATURE

Science Gallery Melbourne

We are animals. We may have pulled ourselves out of the primordial muck by our bootstraps. We may have invented sophistications such as chess, quantum mechanics and the Nutbush. We may have developed consciousness, closely followed by curiosity, hope, and existential despair. But have we forgotten our roots? Sci fight is a quarterly Science Comedy Debate where scientists and comedians come together to debate serious issues in a ridiculous manner.

Date/Time: Saturday 19 Aug, 6:30PM - 8:00PM
Price: Free
Location: Science Gallery Melbourne (700 Swanston Street, Carlton)

More Information / Registration:
scifight.com.au/event-info/free-national-science-week-special-we-should-embrace-our-animal-nature

MUSEUMS VICTORIA EVENTS

BEYOND THE SCREEN – IMMERSIVE VIRTUAL EXPERIENCES OF THE FUTURE

Museums Victoria

You don't need to be a billionaire to become a space tourist. Nor do you need a time machine to witness 22nd-century landscapes ravaged by climate-change. You just need virtual reality (VR). Embark on a trip to the future where interactive VR gaming brings immersive experiences to life, and chat to developers about the ways that video games can help us understand the world's most pressing issues and build a better tomorrow.

Date/Time: Sat 19 Aug & Sun 20 Aug 10:00AM-1:00PM
Price: $10-15
Location: Science Gallery Melbourne (700 Swanston Street, Carlton)

More Information / Registration:
scienceweek.net.au/event/beyond-the-screen-immersive-virtual-experiences-of-the-future/

BLACK HOLES: JOURNEY INTO THE UNKNOWN WITH DR TANYA HILL

Museums Victoria

Imagine a place where time stands still, and the known laws of physics don't apply. Black holes are the opposite of existence, a fact which garners intense curiosity and intrigue. Witness all that is extreme and fascinating about black holes and hear from Melbourne Planetarium's resident astronomer, Dr Tanya Hill, about the search for answers in the cosmos.

Date/Time: Sunday 20 Aug, 6:15PM - 7:15PM
Price: $20 - 30
Location: Melbourne Museum (11 Nicholson Street, Carlton)

More Information / Registration:
scienceweek.net.au/event/black-holes-journey-into-the-unknown-with-dr-tanya-hill/

SCIENCE ON SHOW

Museums Victoria

See some of the rarest and most fascinating species displayed at Melbourne Museum. Hear from Museums Victoria scientists about everything from ancient fossils to live exhibits. Create your own Marvellous Megafauna World, Microbat, Triceratops Mask or Sea Bunny to take home while learning about endangered species and their habitat.

Date/Time: Saturday 12 Aug & Sunday 20 Aug, 10:00AM - 3:00PM
Price: Free (with museum entry)
Location: Melbourne Museum (11 Nicholson Street, Carlton)

More Information / Registration:
scienceweek.net.au/event/science-on-show-2/

STEM WORKSHOP: ENERGY IS A SUPERPOWER

Museums Victoria

Science is a superpower! These workshops explore how strength, curiosity, calmness, energy and kindness are powerful qualities when working within STEM. During National Science Week, girls and non-binary people are invited to explore the many forms of energy we use to power our lives. Through captivating shows and fun STEM activities, learn about different sources of energy and ways that energy can be utilised, while considering the environmental impact.

Date/Time: Saturday 19 Aug, 10:30AM - 3:00PM
Price: $42-52
Location: Scienceworks (2 Booker Street, Spotswood)

More Information / Registration:
scienceweek.net.au/event/stem-workshop-energy-is-a-superpower/

WONDERS OF THE DEEP SEA – INDIAN OCEAN SEASCAPES AND BIODIVERSITY REVEALED

Museums Victoria

Over two research voyages aboard CSIRO's RV Investigator, teams of scientists mapped & sampled seamounts and the seafloor around Christmas and Cocos (Keeling) Islands. Tim O'Hara, Expedition Chief Scientist will describe how the team studied this vast, mysterious ecosystem and the ancient volcanic seascape they mapped in detail for the first time.

Date/Time: Wednesday 16 Aug, 6:00PM - 7:15PM
Price: $0-12
Location: Melbourne Museum (11 Nicholson Street, Carlton)

More Information / Registration:
scienceweek.net.au/event/wonders-of-the-deep-sea-indian-ocean-seascapes-and-biodiversity-revealed-3/

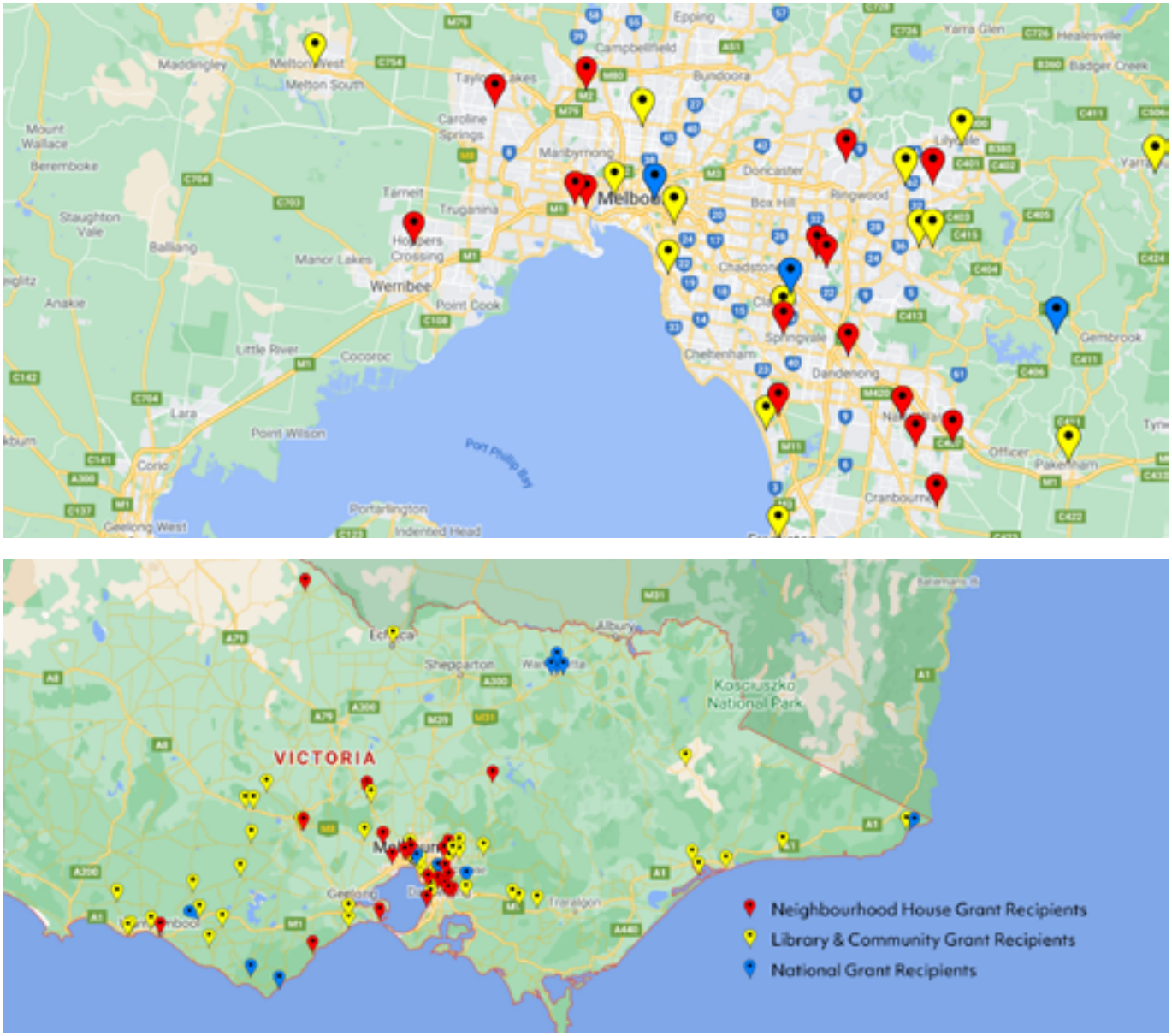
BITE-SIZED SCIENCE – HOW TO TELL IF A STICK CAN WALK? THE HIDDEN WORLD OF STICK INSECTS

Museums Victoria

Sometimes a stick isn't just a stick – it is a stick insect. The history of stick insects is full of close calls in terms of extinctions. Despite their own resourcefulness – using ants to raise their babies, scaring predators by mimicking scorpions and, of course, incredible camouflage – they need our help to survive. Learn more about these tricky and sticky insects and how you can spot them in your own backyard.

Date/Time: Saturday 12 Aug, 12:00PM - 1:00PM
Price: Free (with $5 museum entry)
Location: Melbourne Museum (11 Nicholson Street, Carlton)

More Information / Registration:
scienceweek.net.au/event/bite-sized-science/



PLANTING THE SEEDS OF CURIOSITY:

National Science Week events supported by Seed Grants.

Supported by the Victorian Department of Education, the Inspiring Victoria program has provided Community Grants to fund events at 18 public libraries and community organisations across the state.

Victorian libraries bring the science from books on their shelves to life and community groups get together to think about how science can improve their community and lives. These events attract a wide audience from children to adults, citizen scientists to professionals, encouraging a broader interest in scientific pursuits, and inspiring young people to be curious and fascinated by the world we live in.

Please congratulate the following grant recipients, who will be delivering these programs during National Science Week (12 – 20 August) this year. We hope you'll check out an event near you!

BALLARAT OBSERVATORY TOUR

Ballarat Libraries & Ballarat Observatory

Ballarat Libraries, in partnership with Ballarat Observatory, invites the community to explore the wonders of astronomy and our natural world. Ballarat Observatory is one of the oldest observatories in regional Australia, with one of the best collections of 18th to 21st Century telescopes. Learn about telescopes, launch water rockets, and see a camera obscura, with complex concepts made fun for all.

Date/Time: Sunday 13 Aug, 2:30PM - 4:00PM
Price: Free
Location: Ballarat Observatory

More Information / Registration:
scienceweek.net.au/event/ballarat-observatory-tour/

BIG SCIENCE BIG FUN SHOW

Frankston City Libraries

Fizzics Education is coming to Frankston, and they're bringing gigantic bubbles, flying toilet paper, hair-raising electricity experiments, levitating beach balls, a nail chair to sit on, fire balls, coloured shadows, and much more. It will be a thoughtful and hands-on experience for the children – and the big kids (adults) too.

Date/Time: Saturday 12 Aug, 12:00PM - 1:00PM
Price: Free
Location: Frankston Library

More Information / Registration:
scienceweek.net.au/event/big-science-fun-show-at-frankston-library/

CODING WITH ROBO TRAINS

Eastern Regional Libraries

Learn the basics of coding by programming an electronic train to move around a train track – all by itself. Coding boosts problem-solving skills, teaches creativity, encourages persistence, and these workshops will cover the basics as well as diving into more advanced lessons. These sessions provide an opportunity to discuss public transport, its social and ecological function, and how it is a sustainable alternative to cars and motor vehicles.

Date/Time: Monday 14 Aug
Location: Boronia Library, Yarra Junction Library, Croydon Library

DEADLY SCIENCE: SCIENCE THROUGH A FIRST NATIONS LENS

Torquay Community House

Join respected First Nations Educator and Gunditjmara woman, Nikki McKenzie, for an evening of knowledge & storytelling. Learn about innovations & practices developed and used by First Nations for >65,000 years, and the scientific principles embedded in cultural practices passed down through their traditions, culture, & stories.

Date/Time: Thursday 17 Aug
Location: Torquay Community House

BUTTERFLY ADVENTURES

Kingston Libraries

When you can't go to the butterfly enclosure in the zoo, it can come to you. Primary school students in the area are invited to come along to be junior entomologists and study butterflies. Delivered by Butterfly Incursions, this program combines a live butterfly interactive tent with rotating activity stations: a science table, a drawing table, a book table, and a word activity table.

Date/Time: Thursday 17 Aug
Location: Chelsea Library & Westall Library

CREATE A WORKING COMPUTER WITH ANYTHING – EVEN PLAYDOUGH!

Eastern Regional Libraries

Children are invited to create any kind of "keyboard" with whatever they have at hand: playdough, bananas, or anything they'd like. Using Makey Makey kits, which have a circuit board, alligator clips, and a USB cable, they can create electrical circuits to send a computer a keyboard stroke or mouse click, just by touching their banana/playdough/item of choice. They will learn about circuits and how computers work in this workshop that is "technology meets creativity".

Date/Time: Saturday 12 Aug
Location: Corangamite Moyne Library branches

EVERYTHING OLD IS NEW AGAIN – A NEW WAY TO MANAGE OUR URBAN ENVIRONMENTS

Geography Victoria

Explore your local environment with experts and learn about sustainable practices and rehabilitation of the environment. Explore the regeneration of Yalukit-willam nature reserve, study the wildlife that persists in the urban areas of Elster Canal, and hear about the sustainable use of water at Rippon Lea Estate.

Date/Time: Saturday 12 Aug
Location: Yalukit-willam, Elster Canal, and Rippon Lea

EVERYONE'S AN INVENTOR

Glenelg Library

An afternoon program that allows every kid to become an inventor! Makey Makey is a versatile invention kit that can be used to teach children about electrical circuits, conductivity, coding/programming, and creative problem-solving. Children can invent and design their own electrical circuits incorporating everyday objects, such as fruits, vegetables, or other conductive materials. This helps students think like an inventor and see the whole world as a construction kit.

Date/Time: Tuesday 15 Aug & Friday 18 Aug
Location: Casterton Library & Portland Library

EXPLORING CAREERS IN STEM

Melton City Libraries.

Interested in a career in STEM? Data scientist Ingrid Freeman, TwistED science presenter and IT and space science student Daniel Masini, and web developer and engineering student Josh Quinal will speak about their journeys working in the STEM industry.

Date/Time: Thursday 17 Aug, 6:00PM - 7:30PM
Price: Free
Location: Melton Library

More Information/Registration:
scienceweek.net.au/event/exploring-careers-in-stem/

GET THE BALL ROLLING

Goldfield Libraries

A marble run is essentially a form of Rube Goldberg machine, a chain reaction–type machine or contraption designed to perform a simple task in an indirect and (impractically) overly complicated way. Get the ball rolling this National Science Week by creating your own idiosyncratic marble run with ramps, tunnels, jumps, and funnels. Set yourself a challenge, use your STEM skills, and see where your imagination takes you.

Date/Time: Sat 5 Aug - Sat 12 Aug, 10:00AM - 12:00PM
Price: Free
Location: Woodend Library

More Information/Registration:
scienceweek.net.au/event/get-the-ball-rolling/

MEET EINSTEIN

Campaspe Library

Preschoolers are getting the chance to meet Einstein in a special Science Week Storytime. Children will be invited to wear lab coats while listening to a story called 'Meet Einstein', which covers some of his discoveries, and watch experiments that explore gravity, electromagnetism, and chemistry.

Date/Time: Friday 18 Aug, 10:30AM - 11:30AM
Price: Free
Location: Echuca Library

More Information/Registration:
scienceweek.net.au/event/meet-einstein/

POWER UP PAKENHAM: LEARN ABOUT ELECTRICITY

My Library Community

Learn about electricity and electronics in a hands-on, fun workshop. Build your own circuits and motors, experiment with electromagnetism, and explore other electrifying topics that will spark an interest in STEM.

Date/Time: Tuesday 22 Aug, 5:00PM - 6:00PM
Price: Free
Location: Pakenham Library

More Information/Registration:
scienceweek.net.au/event/power-up-pakenham-science-week-at-pakenham-library/

PROFESSOR BUNSEN

Northern Grampians Libraries

Professor Bunsen, a skilled educator and scientist, will thrill and excite with the science of forces and motion. Students are invited to attend with their schools to experience the amazing power of pull and pull, with floating children, gas bazookas, smoke cannons and a water rocket.

Date/Time: Friday 25 Aug, 9:30AM - 10:30AM & 1:30PM - 2:30PM
Price: Free
Location: Stawell Library & St Arnaud Library

More Information/Registration:
scienceweek.net.au/event/professor-bunsen-presented-by-northern-grampian-libraries/

RETRO GAME DESIGN WORKSHOP

Eastern Regional Libraries

Learn and practice game design principles as you use block coding to create a retro arcade game. Be introduced to block coding concepts and then be tasked with creating a simple retro-style game that gets a character to move around a screen. From customising a character and programming it to move, to considering other game design concepts, there's an opportunity to build on your coding skills no matter what level you are.

Date/Time: Wednesday 16 Aug
Location: Lilydale Library & Ferntree Gully Library

SCOUTING THE SKIES

2nd Mornington Sea Scouts

At the 2nd Mornington Sea Scout Hall, the Scouting youth have been busy designing a mission: to construct and program a balloon to be launched into the sky to record atmospheric data. Weather permitting, the balloon will take flight during National Science Week to measure temperature, air pressure, and even capture panoramas of the stratosphere.

Date/Time: Sunday 13 Aug
Location: Centenary Park, Ararat

SPARKING SCIENCE

Merri-bek Libraries

A fun-filled interactive event aimed at pre- and school-aged children and their parents to discover the many facets of science, and to encourage discussion and deeper understanding of what science means and how it can contribute to all areas of our lives.

Date/Time: Friday 18 Aug
Location: Coburg Library

THIS PLAY WAS WRITTEN BY CHATGPT

Pint of Science

What kind of play shall we write? Using input from the audience, witness captivating short plays written by ChatGPT. Between each segment, delve into enlightening explanations about AI, ChatGPT's inner workings, and the future of Machine Learning and AI. Join for an hour of thought-provoking drama and insightful discourse, as improv actors and scientists unravel the potential of AI-generated art and explore the ever-evolving landscape of technology.

Date/Time: Thursday 17 Aug
Location: Impro Melbourne Theatre (21/23 Stanley St, West Melbourne)

SOLAR CARS

East Gippsland Shire Library

Solar cars are in high demand – and children can build their own. We are currently using solar power in our day-to-day lives to benefit the community. Learn about where solar power comes from, how it works, and what we can do with solar power. Children will hear all about it and construct their own solar vehicle in a hands-on workshop.

Date/Time: Wednesday 16 Aug
Location: Bairnsdale Library, Lakes Entrance Service Centre, Mallacoota Service Centre, Omeo Service Centre, Orbost Service Centre, & Paynesville Service Centre

STEM ZONE

My Library Community

MYLI and STEM Zone will explore this year's Science Week topic of Innovation: Powering Future Industries in a hands-on workshop. Learn how energy can be produced sustainably, investigate different types of fuel, and explore AI, virtual reality and robotics technologies as you design and build a way forward towards a greener, sustainable future.

Date/Time: Wed 16 Aug - Fri 18 Aug, 4:00PM - 5:00PM
Price: Free
Location: Warragul Library, Drouin Library, & Trafalgar Mobile Library Stop (Trafalgar Hall)

More Information/Registration:
scienceweek.net.au/event/myli-presents-stem-zone-4/

TIME DETECTIVES: COLD CASE

The National Trust of Australia

Archaeologists are time travellers. They use everyday items of the past to peer into the people and culture of the past. As Time Detectives, collect, recover, analyse and interpret archaeological evidence in a simulated archaeological site. Under the guidance of your Dig Director, learn about archaeological methodologies, tools and techniques and use them to investigate.

Date/Time: Saturday 19 Aug, 10:00AM - 12:30PM & 1:00PM - 3:30PM
Price: $15-20
Location: Barwon Grange, Newton and Como House, South Yarra

More Information/Registration:
scienceweek.net.au/event/time-detectives-cold-case/

Above: Attendees of Warrnambool Community Garden's event are putting the FUN into FUNgi (see page 39).

EVENTS SUPPORTED BY NATIONAL SCIENCE WEEK GRANTS

The diversity of Australian science is reflected in the array of events on offer during National Science Week. Around the country, 32 grants have been awarded to groups who are bringing science to their communities, six of which are based in Victoria.

The full announcement, including details of events funded in other states, can be viewed at **scienceweek.net.au/national-grant-round-recipients-for-2023/**

Please congratulate the following grant recipients, who will be delivering these programs during National Science Week (12 – 20 August) this year and consider attending an event near you.

SHIRTY SCIENCE – FAVOURITE SCIENCE SHIRT

Madison Hartill Law

Ten brilliant minds have collided to create the ultimate fusion of science, creativity, and shirts. Now they need your help to determine which one is The Most Excellent Science Shirt. In a livestream hosted by ABC Breakfast Presenter, Nate Byrne, scientists and artists from around the country will pitch their innovative science shirt designs for you to vote.

Date/Time: Tuesday 15 Aug, 6:30PM - 7:30PM
Price: Free
Location: Online

More Information/Registration:
scienceweek.net.au/event/shirty-science-presents-the-most-excellent-science-shirt/

THE NATIONAL QUANTUM AND DARK MATTER ROAD TRIP

Monash University

The annual National Quantum & Dark Matter Road Trip is heading to schools, libraries, pubs, and other community hubs in regional and remote Victoria (and Queensland and New South Wales). Dark matter is one of the biggest mysteries of the universe – it accounts for 84% of all matter, but we don't yet know what it is. Quantum technologies are crucial in the hunt for dark matter, and they're already used in smart phones and cars, medical imaging, manufacturing, and navigation. The road-trippers are looking forward to spreading their knowledge and enthusiasm of quantum and dark matter

Date/Time: Monday 7 Aug – Friday 25 Aug
Price: Free
Location: Melbourne, Korumburra, Mallacoota, Wangaratta, Terang, Lavers Hill, & Apollo Bay

More Information/Registration:
qdmroadtrip.org

INSPIRED BY TECH REGIONAL FESTIVAL

DTAC Wangaratta

With science pub quizzes, workshops, and career showcases, The DTAC Wangaratta team are thrilled to announce a line-up of captivating events designed to inspire, educate, and showcase the wonders of STEM. The events are: *Girl Powered Workshop, the Quantum and Dark Matter Pub Quiz, Unleashing STEM Potential: Alumni Journeys and Cutting-Edge Research for Tomorrow's Innovators,* and *Inspired by Tech showcase: Inspiring Minds, Shaping the Future*.

Date/Time: Wednesday 2 Aug – Friday 18 Aug
Price: Free
Location: Wangaratta Club, Wangaratta Library, Wangaratta Digital Hub, & Galen Catholic College

More Information/Registration:
scienceweek.net.au/event/inspired-by-tech-regional-festival-quantum-and-dark-matter-pub-quiz/
scienceweek.net.au/event/inspired-by-tech-regional-festival-unleashing-stem-potential/
scienceweek.net.au/event/inspired-by-tech-regional-festival-girl-powered-workshop/
scienceweek.net.au/event/inspired-by-tech-regional-festival-inspired-by-tech-showcase/

MULTISENSORY SCIENCE BOOK EXHIBITION FOR BLIND AND LOW VISION PEOPLE

Monash University

'Read' about immune system cells through your sense of touch or learn about food and nutrition through a 3D soundscape. The Multisensory Science Book Exhibition features a series of interactive works designed for late primary through to secondary students with low vision, blindness, and diverse needs, including interactive multisensory books, tactile art, posters, sculptures, and data sonification.

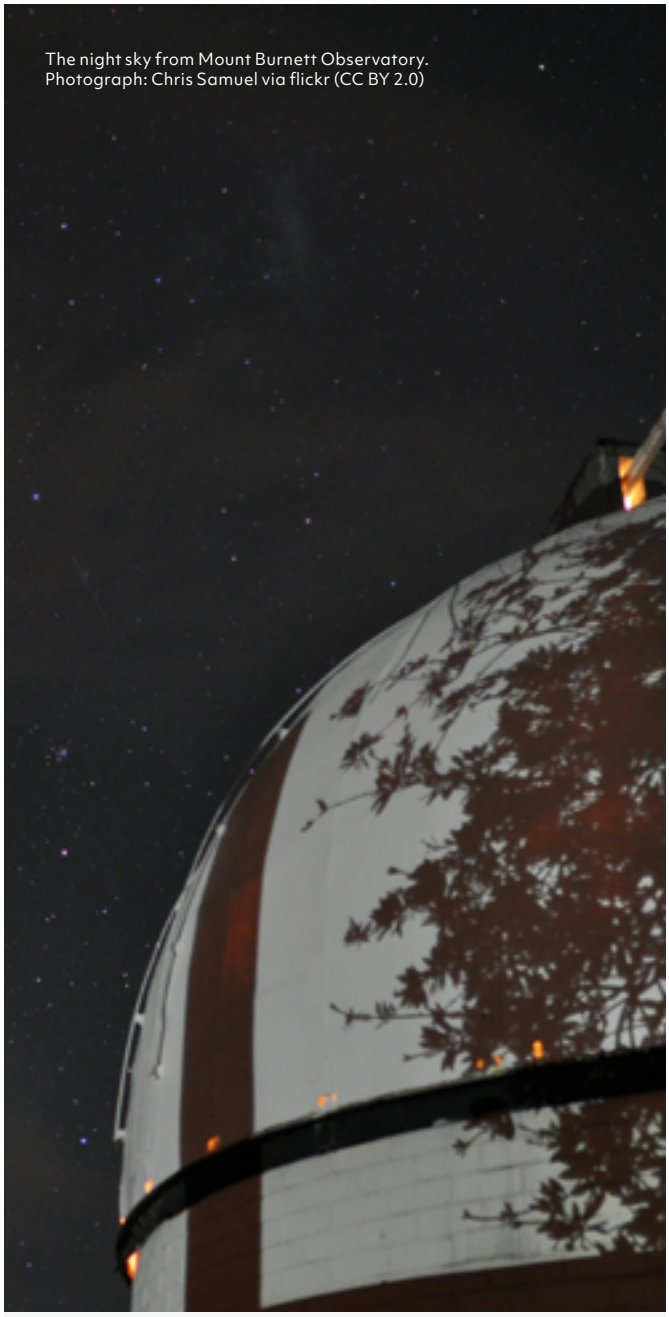
BIONICS INSTITUTE 2023 OPEN HOUSE

The Bionics Institute of Australia

Learn how researchers are solving medical challenges with technology at the Bionics Institute Open House in one of four tours. Get hands-on experience in world-class laboratories and hear about the ground-breaking medical devices and treatments our researchers are developing for Alzheimer's disease, hearing impairments, Parkinson's disease, arthritis, and other conditions.

Date/Time: Wednesday 16 Aug, 11:30AM - 5:00PM
Price: Free
Location: Bionics Institute

More Information/Registration:
scienceweek.net.au/event/bionics-institute-open-house/



The night sky from Mount Burnett Observatory.
Photograph: Chris Samuel via flickr (CC BY 2.0)

FOOTY OVAL ASTRONOMY

Mount Burnett Observatory

The Mount Burnett Observatory team are taking over the local footy oval for a night of astronomy. View the night sky through telescopes to spot Saturn, Mars, Mercury, the Moon, and many stars. Learn how telescopes work and how to use one, hear from Krystal de Napoli, co-author of "Sky Country", a book on Indigenous astronomy, see the astrophotography display, meet Monash University's High Powered Rocketry team, and explore the cosmos.

Date/Time: Sunday 19 Aug, 7:00PM - 10:00PM
Price: Free
Location: Monbulk Rangers Soccer Ground

More Information/Registration:
scienceweek.net.au/event/footy-oval-astronomy/

NEIGHBOURHOOD HOUSES ARE CELEBRATING NATIONAL SCIENCE WEEK

In partnership with the Inspiring Victoria program and the Royal Society of Victoria, Neighbourhood Houses Victoria are supporting 25 Neighborhood Houses throughout the state to deliver a Science Week event. These events align with a number of the United Nations Sustainable Development Goals and encourage an interest in the science within our daily lives.

For more information on any of these events, visit **scienceweek.net.au/find-events**

HUNGRYMINDS @ ALEX HUB

Be a pioneer and flex your scientific curiosity in a workshop full of challenges to problem-solve suitable for all ages.

Date/Time: Thursday 17 Aug
Location: Alexandra Community Hub

KIDS IN THE GARDEN

Learn how food grows in the garden and ends up on your plate in a hands-on workshop suitable for children.

Date/Time: Monday 21 Aug
Location: Brentwood Park Neighborhood House

STEM BUDDY INTRO TO EV3 CODING & ROBOTICS

Learn STEM concepts as you program an EV3 robot in a workshop suitable for children aged 8-12.

Date/Time: Sunday 27 Aug, 1:00PM - 3:00PM
Location: Balla Balla Community Centre

LET'S GET EXPERIMENTAL!

Create slime and fizzing bath bombs, make different types of dough, or design apps and 3D models in three different workshops suitable for children.

Date/Time: Tuesday 15 Aug/Wednesday 16 Aug/ Thursday 17 Aug, 4:00PM-5:00PM
Location: Glenroy Neighborhood House

WATER BUGS AS RIVER HEALTH INDICATORS

Learn from a local Waterwatch scientist to be a citizen scientist who monitors the health of the waterways in a workshop suitable for adults.

Date/Time: Wednesday 16 Aug, 9:30AM - 12:00PM
Location: Ballarat East Neighborhood House

JUNIOR LAB - WEIGH IT, STACK IT, MAGNETISE IT!

Junior physicists learn about weight, light, and magnets in a workshop of demonstrations and stories suitable for children.

Date/Time: Tuesday 15 Aug, 9:30AM - 11:30AM
Location: Japara Neighborhood House

SPECTACULAR SCIENCE

A kitchen is essentially a chemistry lab - a fun food workshop suitable for children.

Date/Time: Monday 14 Aug, 3:45PM - 5:00PM
Location: Aspendale Gardens Community Service

INQUISITIVE KIDS PROGRAM

Fizzics Education will deliver an engaging and educational program suitable for primary school students.

Date/Time: Monday 14 Aug, 4:00PM - 5:00PM
Location: Kerrie Rd Neighborhood House

CREATING GREEN WORLDS: TERRARIUM MAKING AND ENVIRONMENTAL EDUCATION

Explore the fascinating world of ecosystems and learn the impacts of climate change as you make a terrarium in a workshop suitable for children.

Date/Time: Tuesday 15 Aug, 4:00PM - 6:00PM
Location: Fraser Rise Children's & Community Centre

HAPPY KIDZ SCIENCE SHOW

A fun, interactive science show exploring the physics and chemistry of explosions, levitation, and more, suitable for pres-school children and families.

Date/Time: Monday 14 Aug, 10:00AM - 12:00PM
Location: Lorne Community House

GETTING INTO SCIENCE

Young people are invited to peer down microscopes and use magnifying glasses in a science & nature workshop suitable for preschool/primary aged children.

Date/Time: Saturday 12 Aug, 10:30AM - 11:30AM
Location: Park Orchards Community House & Learning Centre

LEARN HOW TO COMPOST: NORTH DANDENONG

Learn about composting and its benefits in a hands-on workshop that will be accessible for CALD communities.

Date/Time: Wednesday 16 Aug, 10:00AM - 12:00PM
Location: North Dandenong Neighborhood House

OUR CHANGING EARTH/ EARTH IN SPACE

Investigate the solar system and the forces that hold the planets in orbit, and learn about weathering and erosion - and how they are affected by human activities - in two activities suitable for children.

Date/Time: Saturday 12 Aug, 4:00PM - 6:30PM
Location: Hampton Park Community Park

KNH SCIENCE IS FUN SESSION

Explore kitchen science or magnets in a workshop suitable for children aged 7-12.

Date/Time: Sunday 20 Aug, 1:00PM - 3:00PM
Location: Kerang and District Community Centre

SHOOTING FOR THE STARS

Build a rocket and hunt for meteors in a space scavenger hunt for children and families.

Date/Time: Wednesday 16 Aug, 10:00AM - 1:00PM
Location: Kyneton Community House

MAKE SCIENCE FUN!

Make slime and use different materials to investigate science in a workshop suitable for children - you'll even receive a kit to continue the science at home.

Date/Time: Wednesday 16 Aug, 10:30AM - 12:00PM
Location: Mount Eliza Neighborhood House

CODING & ROBOTICS WORKSHOP FOR KIDS

Learn how to program a robot and even code it to battle in a workshop for children aged 8 and above. In a separate workshop for all families, learn how to use a worm farm and plant fruit & veg in the garden bed.

Date/Time: Tuesday 15 Aug, 4:30PM - 6:30PM/Friday 18 Aug, 10:00AM - 11:00AM
Location: Oakgrove Community Centre

LEARN HOW TO COMPOST: SPRINGVALE

Learn about composting and its benefits in a hands-on workshop that will be accessible for CALD communities.

Date/Time: Tuesday 15 Aug, 10:00AM-12:00PM
Location: Springvale Neighborhood House

KINDERGARTEN SCIENCE INCURSION

An interactive incursion for children who attend 3-year-old kindergarten.

Date/Time: Monday 14 Aug, 10:00AM - 11:30PM
Location: The Grange Community Centre

PUT THE FUN INTO FUNGI!

Grow your own mushrooms with facilitators from the Warrnambool Botanic Gardens and Warrnambool Community Garden who will share their knowledge of fungi and their important role in the environment

Date/Time: Wednesday 16 Aug, 12:00PM
Location: Warrnambool Neighbourhood Community Centre

SCIENCE FOR A SUSTAINABLE FUTURE

Build simple circuits, explore solar and wind power, make a bird feeder, plant vegetables and participate in a scavenger hunt in an event for children aged 8-12.

Date/Time: Saturday 12 Aug, 10:30AM - 12:00PM
Location: Queenscliff Neighborhood House

LITTLE SCIENTIST'S BIG DREAM

Activities, demonstrations, and a science show for children aged 7-10 to inspire young minds, foster a passion for science, and encourage critical thinking.

Date/Time: Friday 18 Aug, 3:30PM - 5:00PM
Location: South Kingsville Community Centre

BREAKER SPACE

Save old tech from the landfill - pull machines apart to learn how they work in a workshop suitable for teens.

Date/Time: Wednesday 23 Aug, 4:30PM-5:30PM
Location: Woodend Neighborhood House

SCIENCE IN ACTION - STEM ROBOTICS & FERMENTATION KITCHEN SCIENCE WORKSHOPS

Learn principles of robotics, electrical and mechanical engineering, and physics in a STEM robotics workshop, or learn about gut health and fermentation in a wholesome (diet) workshop suitable for all ages.

Date/Time: Saturday 12 Aug, 10:30AM - 12:00PM
Location: Yarraville Community Centre

CALL FOR SCIENTIFIC PAPERS

The *Proceedings of the Royal Society of Victoria* is our refereed journal, published twice annually by CSIRO Publishing. Current and recent editions are available online in open access format from **publish.csiro.au/rs.**

The Society invites contributions for the *Proceedings* from authors across the various disciplines of biological, physical and earth sciences, including multidisciplinary research, and on issues concerning technology and the applied sciences.

Contributions on topics that are relevant to Victoria and the south-eastern Australian region are encouraged. The journal also publishes Special Issues and themed collections of papers commissioned by the Council of the Royal Society of Victoria. It is published online in May and November, with two issues constituting a volume.

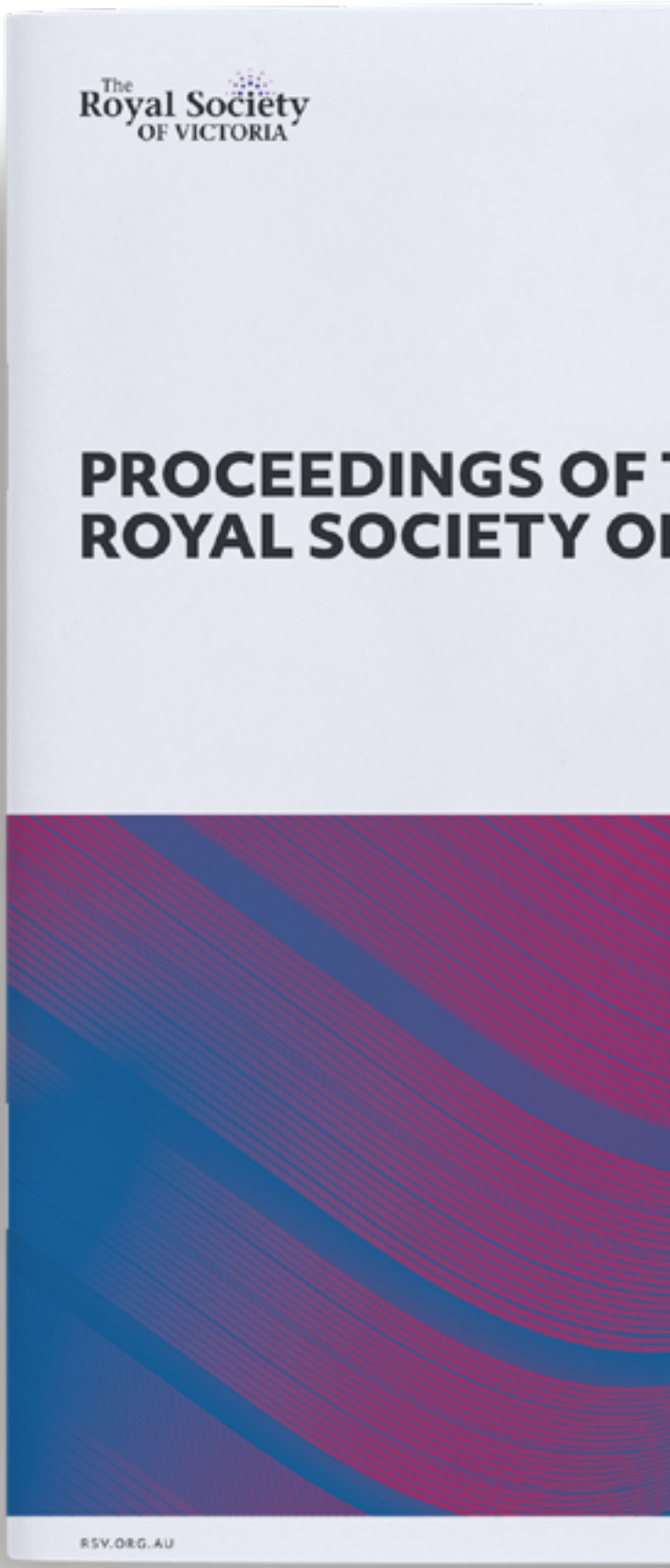
The *Proceedings* is one of Australia's oldest and longest-running science journals, a terrific platform for establishing an individual research presence, grouping papers derived from symposia on specific subjects, or simply joining a distinguished tradition of science published in or about our region that stretches back to the 1850s.

The journal began in 1855 as an irregular publication under the title *Transactions of the Philosophical Society of Victoria*, the present name being adopted in 1889. Since then, the journal has appeared on a regular basis, at first annually but varying from one, two or four parts per year. Since 1889, the parts issued each year were deemed to make up a volume. The online content extends back to Volume 118, Number 1, 2006.

Those interested in submitting papers should review the **Guidelines for Authors**. All enquiries and manuscript submissions should be forwarded via email to **editor@rsv.org.au**.

Please note copies of the *Proceedings* 1854 to 2006 are freely available online at the State Library of Victoria website in their 'Digitised Collections.'

SOCIAL MEDIA
Follow the journal on social media using the hashtag *#ProceedingsRSV*



CURRENT GOVERNMENT CONSULTATIONS OF INTEREST TO VICTORIA'S SCIENCE COMMUNITY

*Projects open for consultation from **engage.vic.gov.au/project***

Victorian Murray Floodplain Restoration Inquiry and Advisory Committee.

Learn about the Standing Inquiry and Advisory Committee appointed to advise on the proposed Victorian Murray Floodplain Restoration Projects and their potential effects

Ongoing:
engage.vic.gov.au/VMFRP-SIAC

Suburban Rail Loop East

Help us shape the design and plans for building Suburban Rail Loop East.

Consultation closes 4th of August 2023:
engage.vic.gov.au/suburban-rail-loop-east

Container Deposit Scheme Refund Sharing Protocol Consultation

Have your say on Recycling Victoria's proposed container deposit scheme refund sharing protocols.

Consultation closes 11 August 2023:
engage.vic.gov.au/container-deposit-scheme-refund-sharing-protocol-consultation

Kitjarra-dja-bul Bullarto langi-ut Masterplan

The Corangamite Catchment Management Authority is currently developing a masterplan for the lower Moorabool and lower Barwon river corridors stretching from near Meredith to the estuary at Barwon Heads.

Consultation closes 14 August 2023:
engage.vic.gov.au/kitjarra-dja-bul-bullarto-langi-ut-masterplan

Victorian Biosecurity Strategy Consultation

Have your say on how to strengthen the biosecurity system in Victoria to protect our land, waters, communities, culture, and economy.

Consultation closes 16 August 2023:
engage.vic.gov.au/victorian-biosecurity-strategy-consultation

PITCHING AND WRITING FOR SCIENCE VICTORIA

Science Victoria seeks the discussion and promotion of scientific topics of relevance to people living in the State of Victoria. We are particularly interested in new research, in-depth articles, or exploration of subjects where scientific work and thinking can directly address or deepen our understanding of environmental and socioeconomic challenges.

We welcome your pitches and pieces for news, features, opinion, and analysis articles on current scientific research in Victoria, recent scientific discoveries, related social and policy issues, technical innovations, and overviews of impactful research. We cover a broad range of topics around Science, Technology, Engineering, Mathematics, Medicine/health (STEMM) under an overarching theme of "science and society."

Science Victoria's articles are written in plain, non-academic language, pitched at an intelligent and naturally curious audience that does not necessarily hold subject-matter expertise. This is not a platform for scientific journal articles nor media pieces. For more information on what we're looking for, please read our article submission guidelines below.

HAVE AN IDEA FOR AN ARTICLE?
PITCH YOUR IDEA TO US!
Send your idea to **editor@sciencevictoria.org.au,** along with any questions you have regarding your pitch.

In your email, please outline:

- In one sentence, what is your key message? (No more than 50 words)
- Why should this key message be shared with the readers of *Science Victoria*? (No more than 100 words)
- Which style of article are you proposing to write? (See below for a guide to article types)

Article pitches can be submitted at any time, but please keep in mind the article submission deadlines for the next month's issue. Note that we may accept your pitch, but suggest it is more suitable for another style of article.

ARTICLE SUBMISSION
Once your pitch has been accepted, you can submit completed pieces that comply with the style guide below. Completed articles to be published in the next issue of *Science Victoria* must typically be submitted 2 weeks prior to the beginning of the next month.

All pieces will be reviewed prior to publishing and may be edited for length and clarity (although we will be sure not to alter the message or context of your work). We will also endeavour to fact-check and confirm any grey areas with you ahead of publishing in the interests of accuracy.

All published pieces will be accompanied by a by-line, and a short (<50 word) biography of the author (title, institution, qualifications, current projects, contact email) to be submitted with your piece.

Images and figures to accompany your piece are strongly encouraged, however please ensure that you only provide original images produced by yourself or those that already exist in the Public Domain. Images must include details of the source and any relevant descriptions. If you do not provide any images, and any relevant descriptions. If you do not provide any images, we may include Public Domain or stock images that we deem suitable for visual communication of your content.

REFERENCES
References for all articles should use a modified APA 7th edition format: reference list in author-year format, with numbered in-text citations. Refer to articles in previous editions for examples, or contact **editor@ScienceVictoria.org.au**.

WRITING FOR SCIENCE VICTORIA: ARTICLE FORMATS

STYLE GUIDE

To successfully engage the largest audience, all pieces should have readability in mind.

Readability can be determined using a Flesch-Kincaid readability test, aiming for a score between 50-60. This score means that your piece should be easily understood by an educated 16-year-old (a year 10 student).

If drafting your piece in Microsoft Word, **you can easily view your document's readability statistics** at Home>Editor>Document Stats. Alternatively, you can use one of the many free online calculators.

FEATURE ARTICLES

Recommended word count (600 - 1,800)

Feature articles are more in-depth pieces on a specific topic related to STEMM. A key aspect of feature articles is the narrative – this isn't a journal article, so think about the story that your article is trying to tell.

Your audience is intelligent members of the general public, who share an enthusiasm for scientific topics, or who are members of the scientific community outside of your particular field.

Avoid using jargon, as it will quickly alienate anyone who isn't an expert in that field. Explaining one or two otherwise irreplaceable terms is fine.

Please reference primary sources/journal articles for any non-trivial scientific claims, or for publications that prompted your writing of the article.

Feature articles typically run between 600 and 1,800 words (including references). Use of sub-headings and figures to break up longer pieces is strongly encouraged.

Not quite sure about the tone for your piece? Have a look at articles published in previous editions of *Science Victoria*, or in other scientific magazines for a general audience, like *The Conversation, Cosmos, New Scientist* or *Scientific American*. A good litmus test is knowing that most of us have read a piece or been to a presentation that managed to make the most interesting topics incredibly boring. This is what you want to avoid.

LETTERS

Recommended word count (400 - 1,000)

Letters have minimal restrictions on style, structure, or subject matter. You are encouraged to submit your thoughts/questions/comments that broadly relate to STEMM in Victoria and/or the Royal Society of Victoria. Potential subject areas include responses to articles in previous editions of *Science Victoria*, seminars at scientific events, science-related issues and policies, or topics you'd like to see in future editions.

Where a specific question is asked, we will endeavour to have the appropriate person respond to your letter.

WHAT I'VE BEEN READING

Recommended word count (400 - 1,000)

This is a column for you to tell us about a book broadly relating to science that you've read. These pieces are typically between 400 – 1,000 words and include a summary of the book and its ideas, as well as your interpretations or conclusions.

Possible questions to consider when writing this column:

- Do you think the author was correct in any assumptions?
- Was the author's style of writing approachable?
- Did they do the subject matter justice?
- Who would you recommend this particular book to?
- What did it mean to you?
- What did you learn?

OPINION ARTICLES

Recommended word count (600 - 1,000)

In contrast to an unbiased news or feature article, an opinion piece conveys your informed opinion on, or experiences with a particular topic. This is where your expertise on a subject can shine. Clearly state your argument, outlining the details of the problem you are addressing, and build to a strong conclusion.

For greatest impact, your choice of topic should be one that is broadly relevant to STEMM-related fields in Victoria. Examples of possible topics include:

- how to address a climate-change related problem in Victoria,
- successes and failures common to STEMM engagement initiatives,
- changes in your particular field of expertise
- your experiences of a career in STEMM and thoughts on how to better support the next generation of researchers,
- existing STEMM-related studies or approaches that you believe could be applied in Victoria,
- ethical problems related to scientific projects or careers in STEMM.

Please reference primary sources/journal articles for any non-trivial scientific claims, or for publications that prompted your writing of the article.

Opinion pieces should aim to be 600-1000 words. For anything shorter, consider submitting it as a Letter instead. We welcome well-informed opinion articles from all authors, particularly from those with significant expertise in a given area. Articles may reference your own work; however these are not promotional fluff pieces.

NEWS ARTICLES

Recommended word count (400 - 1,000)

News Articles are for the discussion of current or recent news relating to science, with an emphasis on science in Victoria or news that impacts Victoria's scientific community.

These articles should be concise, avoid use of jargon and personal opinion, and be referenced as appropriate. News pieces should be between 400-1,000 words in length.

Reports could relate to funding announcements/grant outcomes, new STEMM-related projects, high-impact publications relevant to Victoria, successes of Victorian scientists, or relevant STEMM-related policy news.


THE ROYAL SOCIETY OF VICTORIA
Promotion and Advancement of Science

HOLD YOUR NEXT EVENT AT THE ROYAL SOCIETY OF VICTORIA

The RSV engages communities with scientific knowledge through aligned partnerships, special events, festivals, conferences, and education programs. Email **rsv@rsv.org.au** to discuss your needs and ideas!

FACILITIES FOR HIRE

The Royal Society of Victoria's facilities are available for hire to organisations, companies, or private groups. This heritage-listed building opposite the Carlton Gardens is suitable for a wide range of events, including conferences, seminars, meetings, and private functions.

Limited parking is available on-site and a commercial parking operator is adjacent on La Trobe Street.

The RSV has audio visual and seminar equipment available for use, including videoconferencing facilities. There is a commercial kitchen on the ground floor, suitable for your own use or by a caterer.

SERVICES AVAILABLE

We provide a number of services to ensure your event is a success. Some of the services we provide are:

- Event management
- Meeting venues
- Grants and awards administration
- Social media campaign management
- Broadcasting and video production
- Campaign management
- Recruitment of scientific panels
- Convening community engagement and deliberation processes where scientific work contributes to social, environmental, and economic impacts and benefits.

The Burke and Wills Room

Multi-functional space with adjoining kitchen.

Capacity:

Workshops	≤30 people
Dinners	≤60 people
Seminars, functions, catering, etc	≤80 people

The Von Mueller Room

Seminar room great for smaller meetings and seminars.

Capacity:

Meetings, seminars, etc	≤15 people

The Ellery Lecture Theatre

Raked seating great for lectures, presentations, and conferences.

Capacity:

Raked seating	≤110 people.

The Cudmore Library

A picturesque room great for larger meetings and seminars.

Capacity:

Meetings, seminars, etc	≤24 people

We are registered as a Certified Social Trader working for the benefit of Victorian communities, which makes our services eligible under the Victorian Government's Social Procurement Framework, as well as the social procurement guidelines of the governments of New South Wales and Queensland. Our certification also assures industries of our authenticity in building social procurement into services and supply chains. For more information and bookings please contact our Business Manager at **james@rsv.org.au** or on +61 3 9663 5259

SUPPORT VICTORIA'S SCIENCE SOCIETY

Founded in 1854, the Royal Society of Victoria (RSV) is our state's science society. We are a membership based, non-government organisation, advocating for the importance of science, technology, innovation, and building the skills for Victoria's future industries, governments, community leaders, and research superstars.

We manage the Inspiring Australia program in Victoria, meaningfully engaging communities with science. We encourage, profile, and celebrate the achievements of Victorian scientists through public lectures, awards, and prizes, which are supported by the donations and bequests to the RSV Science Foundation. Your donations allow us to continue the work we have been doing for Victoria for more than 160 years.

To make a donation, please fill in the form below and return to the Royal Society of Victoria, 8 La Trobe St, Melbourne VIC 3000. Alternatively, you can donate online at **rsv.org.au/support-the-rsv**

RSV 2023 FUNDRAISING CAMPAIGNS

The area of greatest need, as identified by the Society's Council	$
Inspiring Victoria – Community Science Engagement Program	$
Science Awards & Prizes	$
Science History & Heritage	$
Science for All - Citizen Science Programs	$
BioQuisitive Community Lab	$
The Phoenix School Program	$
The BrainSTEM Innovation Challenge	$
Australian Indigenous Astronomy	$
Science Victoria - Magazine and Web Content Production	$
TOTAL	**$**

Personal Details

Title: _____ **Family Name:** _____

Given Names: (In Full) _____

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By submitting this form I acknowledge that the amount entered against 'TOTAL' donations above will be charged to my credit card.

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☐ **Cheque or Money Order**

I enclose my cheque or money order made out to The Royal Society of Victoria.

☐ **Electronic Funds Transfer (EFT)**

I have transferred my donation to the Royal Society of Victoria as follows:
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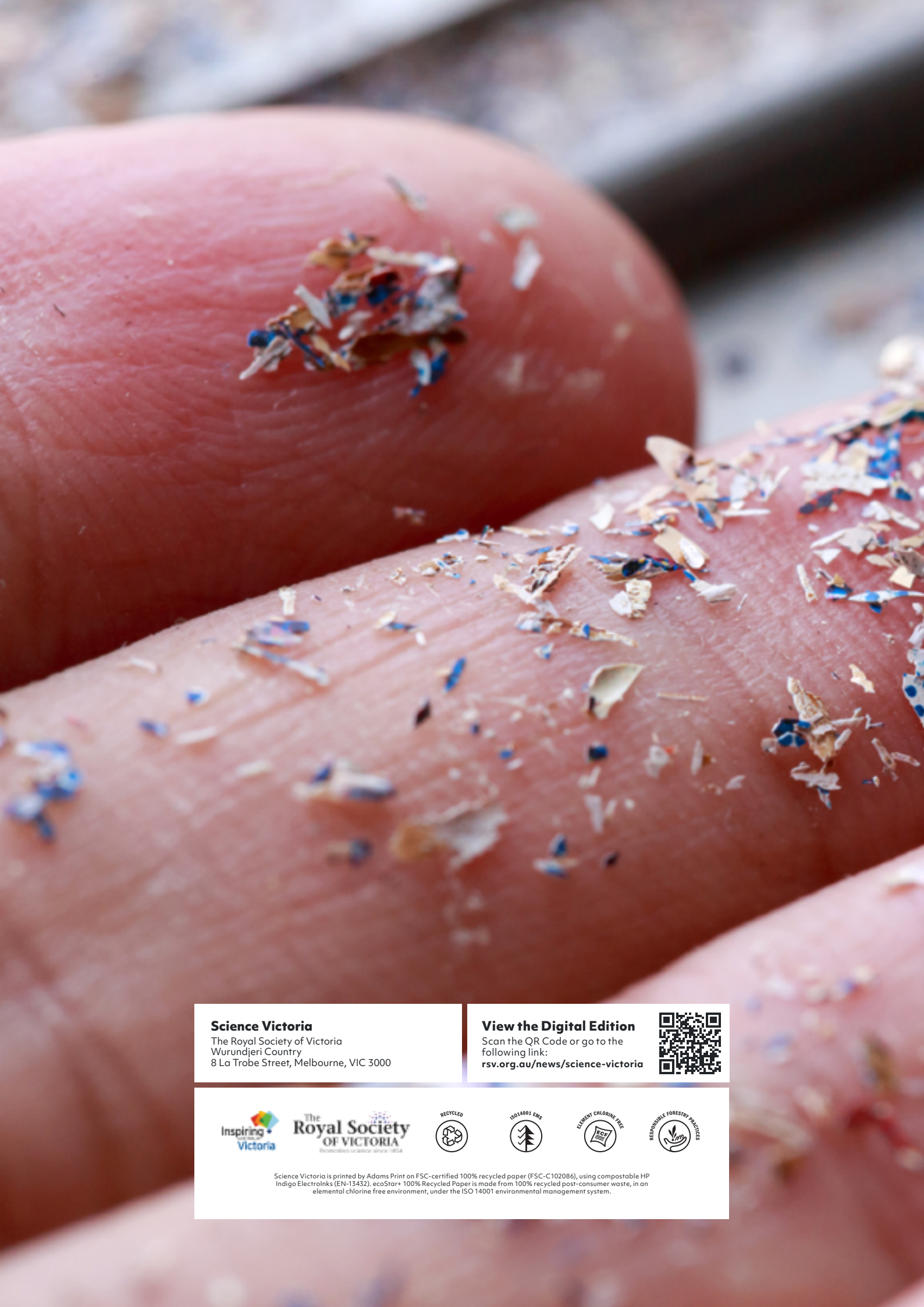

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