

ICWES19

NEW ZEALAND 2023

**CONFERENCE
PROCEEDINGS /
BOOK OF ABSTRACTS**



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Monday 4 September

TIME	SESSION				
0830 - 0900	Mihi Whakataua				
0915 - 1000	Welcome from Conference Convenors Emma Timewell, Bryony Lane				
0915 - 1000	Welcome from INWES President Jung Sun Kim				
0915 - 1000	Common cognitive traps constraining the future of STEM Kristin Alford				
1000 - 1030	MORNING TEA				
1030 - 1230	CONCURRENT 1A Protecting people from natural hazards and other threats to society	CONCURRENT 1B Protecting and restoring the natural environment	CONCURRENT 1C Improving health and healthcare	CONCURRENT 1E Advancing technology	CONCURRENT 1F Ensuring STEM diversity and equality Kindly sponsored by MBIE
	Resolving landscape dynamics in the Fox Glacier/Te Moeka o Tuawe Valley with remote sensing and 3D-change detection Ellorine Carle New Zealand	The role of ecosystem services in restorative marine economies Emily Douglas New Zealand	Antimicrobial graft materials for bone engineering Dawn Coates New Zealand	Emphasizing universities' innovation to achieve sustainability for smart cities mission in India Seema Singh India	Creating a center for STEM excellence in New Mexico – the power of STEM advocacy at the State Government Level in the USA Gail Mattson, USA
	Volcanic Tsunamis: what we know, what we learned from Hunga Tonga-Hunga Ha'apai and what we are doing to keep us safe in the future Emily Lane New Zealand	Establishing a blue carbon methodology for Aotearoa New Zealand Phoebe Stewart-Sinclair New Zealand	The yin and yang of alveolar bone remodelling Trudy Milne New Zealand	Experimental monitoring system of canopy health and environment using IoT technology for deployment in remote sites Celine Mercier New Zealand	Factors that influence young women to pursue their career in STEM in New Zealand Jitty Varghese New Zealand
	Password Managers help to protect our online security... so why are New Zealanders not using them? Lisa Patterson New Zealand	Advocating for marine biodiversity, one squid at a time Kat Bolstad New Zealand	Using bacteriophages to enhance global health: a drug delivery system that could revolutionize cancer prevention in low-income nations Daliya Rizvi, USA	Predicting fruit quality using the mechanistic model Hana Liang New Zealand	The Aotearoa New Zealand longitudinal gender attitudes survey Suzanne Manning New Zealand
	Developing a multi-hazard modelling framework for estimating agricultural production loss Heather Craig New Zealand	Water security under Te Mana o te Wai India Eiloart New Zealand	Optimising Probiotic delivery systems to withstand the rigors of commercial food processing, long shelf-life storage and delivery to the body Ashling Ellis New Zealand	Scale up and automation of Pinus radiata somatic embryogenesis Taryn Saggese New Zealand	Shaping the future through contemporary approaches to engineering education Marlene Kanga Australia
	How can we reduce risk to Aotearoa New Zealand from local landslide tsunami sources? Suzanne Bull New Zealand	Re-orienting preservice chemistry teachers towards sustainability through systems thinking for environmental restoration Ruby Hanson, Ghana		Portable electro-antennograms - working towards a cyborg Brooke O'Connor New Zealand	Q&A

	Q&A			Multi-omics integration pipeline - a test framework to analyze multiple high dimensional biological data. Lindy Guo New Zealand	
				Holmes Solutions use time and motion studies to make sure products and processes are efficient and economical Madeline Burrows New Zealand	
1230 - 1330	LUNCH				
1330 - 1500	<p>ENSURING DIVERSITY AND INCLUSIVITY IN STEM Chaired by Maretha Smit, Diversity Works Mainstreaming LGBT+ diversity, Martyn Loukes Women in a traditionally male sector, NZ Defence Force, Carol Abraham, Emily Kutarski, Rebecca Magdalinos Neurodiversity, Denise Carter-Bennett Māori inclusion and indigenous engagement, Genevieve Doube</p>				
1500 - 1530	AFTERNOON TEA				
1530 - 1700	Panel: How do we get to a future of diversity? Martyn Loukes, NZ Defence Force, Denise Carter-Bennett, Kristin Alford, Genevieve Doube				
1700 - 1830	Poster session				
1900 - 2100	INWES Annual General Meeting (AGM19)				

Tuesday 5 September

TIME	SESSION					
0830 - 1000	SHAPING ANTARCTICA Coordinating science internationally, Chandrika Nath Engineering for Antarctica, Latasha Templeton Science for Antarctica, Vonda Cummings					
1000 - 1030	MORNING TEA					
1030 - 1145	Female perspective of Covid-19 Juliet Gerrard, Siouxsie Wiles					
1145 - 1245	LUNCH					
1245 - 1445	CONCURRENT 2A Protecting and restoring the natural environment	CONCURRENT 2B Ensuring STEM diversity and equality Kindly sponsored by MBIE	CONCURRENT 2C Enhancing liveability through urban transformation	CONCURRENT 2D Providing food security	CONCURRENT 2E Transitioning to clean energy	CONCURRENT 2F Workshop
	The footprint of ship anchoring on the seafloor Sally Watson New Zealand	Improving gender equality in forestry disciplines Beccy Ganley New Zealand	Securing Aotearoa's sustainable housing future with indigenous knowledge: an exploratory study Eziaku Rasheed New Zealand	Food spoilage spore forming bacteria in New Zealand dairy farm environment- A North Island perspective Tanushree Gupta New Zealand	Is less more in the transition to a cleaner energy future? Emma Lloyd & Irene Clausse New Zealand	Telling your story (Science Media Centre) Dacia Herbulock Katrin O'Donnell
	Predicting macroalgal range shifts in Aotearoa New Zealand to inform climate-smart conservation management Katie Cook New Zealand	Women in Space Aotearoa New Zealand: A professional network and supportive community taking action in pursuit of gender equity in Aotearoa's space sector Kate Breach New Zealand	Holmes Solutions develop Whoosh®, a personalised transport system on an elevated network of cable and rail Margot Willis New Zealand	Closing the gap between liking and wanting - improving prediction of consumer behaviour through new methodologies Shannon Bullock New Zealand	Grid operations challenges and policy considerations for integrating renewable resources into the U.S. grid Jill Tietjen USA	
	A novel approach to analyse continuous microchemical information from biological samples reveals changes in migration and habitat-use patterns of snapper (Chrysophrys auratus) Jingjing Zhang New Zealand	The changing face of women in STEM in Aotearoa New Zealand Emma Timewell New Zealand	Functionalised wood-based materials for a sustainable built environment Tripti Singh New Zealand	Beekeeping outside the box: innovative colony handling and hive architecture Ashley Mortensen New Zealand	Retrofitting New Zealand's existing housing stock to support the transition to 100% renewable energy Eloise Blewden New Zealand	

	Seafloor cold seeps offshore Aotearoa – geologically controlled oases of life under threat? Jess Hillman New Zealand	Fighting the labour shortage in the water industry: attracting and retaining immigrants and women Gabriela Campos Balzat & Natalia Moraga Alcaino New Zealand	Q&A panel	Fighting environmental degradation at grassroots: promoting climate smart agriculture technologies amongst communities in Lake Victoria Basin, Kenya Pamella Were Kenya	Accelerating national transitions to low-carbon electricity systems and the implications to metals lifecycles: Case of Aotearoa New Zealand Isabella Pimentel Pincelli New Zealand	
	Oceanographic baseline at a future offshore fish farm site in Cook Strait Marta Ribo New Zealand	Promotion of diversity and inclusion in STEM - some tips on improving Japanese situation Mami Mihara-Narita Japan		The concurrent impacts of drought and leaf harvesting on two traditional African vegetable non-timber forest product species K. Gisele Sinasso S. Benin	Q&A panel	
	The fight against myrtle rust Beccy Ganley New Zealand	A tale from the other side: Establishing an investment system to support amazing science for the future Kieren Arthur New Zealand		African fermented seeds as probiotic carriers for poultry feed and an alternative to antibiotic growth promoters. Elmer Ametefe Ghana		
1445 - 1500	AFTERNOON TEA					
1500 - 1700	CONCURRENT 3A Advancing technology	CONCURRENT 3B Ensuring STEM diversity and equality Kindly sponsored by MBIE	CONCURRENT 3C Protecting people from natural hazards and other threats to society	CONCURRENT 3D Improving health and healthcare	CONCURRENT 3E Workshop	CONCURRENT 3F Workshop
	Extreme exploration, Chinese and New Zealand women scientists and engineers venture into the Kermadec Trench, one of the deepest parts of the Earth's oceans Caroline Chin New Zealand	Controlling unconscious bias Reiko Iijima Japan	A national flood awareness system for ungauged catchments in complex topography for Aotearoa New Zealand: development, communication, and evaluation Celine Cattoen New Zealand	Understanding the health impacts of vaping: are we there yet? Kelly Burrowes New Zealand	Recording your histories as women in engineering & science (INWES)	Successful STEM engagement (GirlGuiding NZ) Maia Faulkner Mirjam Oord
	Real-time invasive marine species detection using computer vision deployed on remotely operated vehicles Rose Pearson New Zealand	Contextual science learning and student motivation: the case of grade 11 girls in a secondary school in Kenya Selline Ooko Kenya	Generating flood maps for all Aotearoa Alice Harang New Zealand	The role and source of respiratory sinus arrhythmia: exploration using mathematical models of heart rate regulation and blood circulation Weiwei Ai New Zealand		

	Microplastic elimination from aquatic systems using nanotechnology based approaches Nishita Narwal India	Diversity and STEM Equality Rufina Dabo Sarr Senegal	Trust Me!! have the Proof: How a provenance based approach can provide more transparency to IoT Healthcare Fariha Jaigidar Australia	Modelling and analyzing the respiratory neural network using Boolean representation Alona Ben-Tal New Zealand		
	Indigenous car driving simulator Kamini Gupta India	Encouraging diversity in engineering through sustainability Paige Chong New Zealand	Responsible and ethical use of genomics in forensics Suzanne Manning New Zealand	Antimicrobial compounds from root, stem bark and seeds of <i>Melia volkensii</i> Rahab Kamau Kenya		
	Using Unity 3D and interactive 3D visualizations to enhance the accuracy and usability of orchard simulations Jane Tsang New Zealand	Inclusive education of women and girls in STEM sectors for local sustainable development in Africa Aude Abamba Mboapfour Cameroon				
	A recurrence of vulnerabilities within Decentralized Finance: analyzing notorious DeFi network exploits and deriving implications for the future Caroline He USA	Why is HE and engineer but SHE isn't? Addressing the female engineering identity in STEM Emma Lloyd & Irene Clausse New Zealand				
	Q&A Panel	Who's doing Surveying and Spatial Science Honours Degrees and what do they get from it? Emily Tidey New Zealand				
1830	CONFERENCE DINNER Hunua Room, Aotea Centre Kindly sponsored by Stantec					

Wednesday 6 September

TIME	SESSION			
0730 - 0830	BREAKFAST			
0830 - 1000	SHAPING SPACE Space Law, Maria Pozza Engineering for space, Imogen Rea Exploring space, Michele Bannister			
1000 - 1030	MORNING TEA			
1030 - 1230	CONCURRENT 4A Improving health and healthcare	CONCURRENT 4B Ensuring STEM diversity and equality Kindly sponsored by MBIE	CONCURRENT 4D Enhancing liveability through urban transformation	CONCURRENT 4E Workshop
	Simplified, saliva-based PCR testing for greater public health impact Anne Wyllie USA	Gender inequity in Australian research grants broadly reflects the workforce Isabelle Kingsley Australia	Engineering innovation and the circular economy Evelyn Laurito Phillippines	Creating a successful engagement programme Claire Lyons Ying Yang Sneh Patel
	Transitioning from PCR and Sanger sequencing to WGS - Legionella typing and beyond Amy Bradshaw New Zealand	Making a difference in the Pacific Andrea Rickard New Zealand	A European view on unlocking the Circular Economy Tania Hyde New Zealand	
	Addressing sex bias in medicine: A sex-specific digital twin of the cardio-respiratory system Kelly Burrowes New Zealand	Writing women scientists back into history Asha Gopinathan India	Digital Innovation: Integrating Planetary Boundaries into Decision-Making Debbie O'Byrne New Zealand	
	An up side to COVID-19? Impact of COVID19 and lockdown on chronic obstructive pulmonary disease admissions to Christchurch hospital Malina Storer New Zealand	Stimulating sustainable entrepreneurial (SSETS) thinking for impactful research and enhanced employability of STEM graduates Mary Mwangi Kenya	Q&A panel	
	Generation Kāinga: Rangatahi building a regenerative and resilient Aotearoa Maia Ratana & Keisha Rawiri New Zealand			
1230 - 1330	LUNCH			
1330 - 1530	CONCURRENT 5A Ensuring STEM diversity and equality Kindly sponsored by MBIE	CONCURRENT 5D Transitioning to clean energy	CONCURRENT 5E Workshop	
	From ICWES9 to ICWES19 - Observations from an ICWES time traveller (15m) Suzanne Wilkinson New Zealand	How do we ensure New Zealand's geothermal use is sustainable? (15m + 5qa) Sophie Pearson-Grant New Zealand	Putting it all into practice - what can you do with what you've learnt this week when you get home? Claire Lyons, Ying Yang Sneh Patel	

	Busting myths about women engineers Daphne Deidre Yong Teng Wong Australia	Generation and emissions of geothermal powerplants in New Zealand. Anu Choudhary New Zealand		
	Perceptions of Gender Barriers in Science and Engineering and the GISE Index: Tools for Change Sarah Peers United Kingdom	The roadmap to net-zero with geothermal resources in Aotearoa New Zealand Sophie Pearson-Grant New Zealand		
	The movement driving change for women in engineering and architecture Charlotte Downes New Zealand	Q&A Panel		
	Making STEM and maths more gender inclusive: lessons from a new model for engineering education Sarah Peers United Kingdom			
	Q&A			
1530 - 1600	AFTERNOON TEA			
1600 - 1700	Including sustainability in every project, Colleen Thorpe Summary, Emma Timewell & Bryony Lane Farewell, Jung Sun Kim			
1700 - 2200	INWES - Incoming, 2024 - 2026 Board of Directors meeting (BM45)			

How can we reduce risk to Aotearoa New Zealand from local landslide tsunami sources?

Dr Suzanne Bull¹, Dr Jess Hillman¹, Dr Sally Watson², Dr Malcolm Arnot¹, Dr Kendall Mollison³, Assoc. Prof Hannah Power³, Dr Lorna Strachan⁴, Dr Kate Clark¹

¹GNS Science, Lower Hutt, New Zealand, ²NIWA, Miramar, Wellington, ³University of Newcastle, Australia, Callaghan, Australia, ⁴University of Auckland, Auckland, New Zealand

Concurrent 1a, Hunua 1, September 4, 2023, 10:30 AM - 12:30 PM

Large underwater landslides can generate near-shore, highly directional tsunami waves without obvious warning such as ground shaking or volcanic eruption. Aotearoa New Zealand is surrounded by thousands of examples of underwater landslides, some on a giant scale. A lack of research means that we understand little about their dynamic triggering, return rates and potential impacts, which limits our ability to incorporate them into tsunami hazard assessments. So, what steps can Aotearoa New Zealand take to address this knowledge gap?

We present an overview of this challenging hazard along with the results of a recent project that advances new physical and statistical descriptions of tsunami generated by underwater landslides. Our approach uses a combination of sedimentary basin analysis, marine geoscience and numerical simulations, focusing on the western margin of North Island/Te Ika-a-Maui in the Tasman Sea/Te Tai-o-Rēhua, where Aotearoa's largest-known underwater landslides (~3,200 km³) have been discovered.

Our project highlights the role of women and early career researchers in this natural hazard research. Our findings underline the need for further high-resolution modelling and more extensive data coverage to assess how ubiquitous underwater landslides were in the past, and the probability of further events in the future.



Developing a multi-hazard modelling framework for estimating agricultural production loss

Dr Heather Craig¹, Ryan Paulik², Alec Wild³

¹NIWA, Christchurch, New Zealand, ²NIWA, Wellington, New Zealand, ³Aon New Zealand, Auckland, New Zealand

Concurrent 1a, Hunua 1, September 4, 2023, 10:30 AM - 12:30 PM

Agriculture is a vital component of Aotearoa-New Zealand's economic and social wellbeing. However, it is also an industry that is highly exposed and vulnerable to a range of hazards; both through direct impacts to animals and vegetation, as well as indirect impacts to the vast range of interdependent infrastructure such as electrical networks and water supplies. Agricultural loss modelling has previously focussed on linking a single hazard intensity measure (e.g., ashfall thickness, flood depth, etc.) to the probability of a given impact (e.g., a production loss range). This approach does not allow for the dynamic modelling of different hazard events through time and the cumulative losses that this may cause.

This study develops a framework for agricultural loss modelling over multiple hazard events through time, focussing on flooding and ashfall in the Tarawera and Rangitāiki catchments. This utilises and updates existing fragility functions for ashfall and develops a new suite of functions for flood impacts. Additionally, recovery coefficients are proposed to allow for the incorporation of fluctuations in production levels in between hazard events dependent on the types and sequence of events and the season that these occur in. The framework will allow for production loss predictions in complex scenarios that will facilitate targeted mitigation measures and recovery planning for the agricultural sector.



Password Managers help to protect our online security... so why are New Zealanders not using them?

Lisa Patterson¹, Dr Ian Welch¹, Dr Bryan Ng¹, Dr Sue Chard¹

¹Victoria University Of Wellington, Wellington, New Zealand

Concurrent 1a, Hunua 1, September 4, 2023, 10:30 AM - 12:30 PM

Users frequently have large numbers of online accounts that require protection. Passwords are the most popular way for users to authenticate or verify their identity. Research has found that users may have more than 100 accounts requiring password protection. To cope with the large numbers of required passwords, users adopt a variety of insecure and impractical strategies. These strategies include writing passwords down, trying to memorise them, and utilising the 'forgot password' function to reset the password. To reduce the quantity to be remembered, passwords are frequently reused, resulting in the risk that security is undermined.

Password managers are available to mitigate this security risk, however results from international studies report that many users do not utilise this technology. Reasons for the low adoption include lack of trust in the technology, and unwillingness to be dependent on the technology. There is low awareness about password managers in the community. Some users do not utilise password managers because they believe they do not have enough passwords to protect, or that their accounts are not valuable enough to protect. Concern has been raised by users over a password manager's potential for single point of failure.

We interviewed a group of 14 remote working professionals in Aotearoa New Zealand (NZ) about their knowledge relating to password security and their own use of passwords. Participants were asked to estimate how many passwords they used, and whether these were reused across multiple accounts. We discussed participants' knowledge of, and attitude towards, password managers. Results yielded concerning results, with none of the participants having utilised a password manager. We investigate the reasons that our group of New Zealanders are not using password managers and discuss the ways that password managers can improve the safety of our residents online.



Volcanic Tsunamis: what we know, what we learned from Hunga Tonga-Hunga Ha'apai and what we are doing to keep us safe in the future

Dr Emily Lane¹, Cyprien Bosserelle¹, Colin Whittaker², Yaxiong Shen², Lily Battershill², Matthew Hayward², Natalia Lipiejko², William Power³, Zhonghou Xu⁴

¹NIWA Taihoro Nukurangi, Christchurch, New Zealand, ²University of Auckland, Auckland, New Zealand, ³GNS Science, Wellington, New Zealand, ⁴NIWA Taihoro Nukurangi, Hamilton, New Zealand

Concurrent 1a, Hunua 1, September 4, 2023, 10:30 AM - 12:30 PM

While volcanic tsunamis represent only around 5% of all tsunamis, their unique generation mechanisms present challenges when trying to understand the hazard that they pose in volcanically active coastal regions and caldera lakes such as the Auckland Volcanic Field, the Taupō Volcanic Zone and along the Tonga-Kermadec Trench. We need to understand this hazard to ensure we can mitigate their impacts in the future.

The Hunga Tonga-Hunga Ha'apai (HTHH) eruption and tsunami was the largest volcanic tsunami since the Krakatau eruption in 1883. It generated a tsunami that was catastrophic locally and the atmospheric pressure waves from the volcano forced meteotsunami waves that were measured around the globe. The local tsunami was generated by a complex combination of several explosive submarine eruptions, pyroclastic density currents, caldera collapse and the atmospheric pressure forcing. While HTHH represents our best measured climactic volcanic eruption to date, the eruption itself was shrouded by the gigantic mushroom cloud which extended 55 km into the atmosphere and a radius of over 250 km from the volcano. There are only a few sea-level and pressure gauges within a few hundred kilometres of the volcano meaning that the near-field record is quite sparse. This makes piecing together what happened on 15 January 2022 something like a detective story.

This talk presents research from a recently completed project funded by a Marsden Grant (Royal Society Te Apārangi) looking at volcanic tsunamis and ties those results in with what we have learned from HTHH. I present our best understanding of how the near-field tsunami was generated. I also discuss various initiatives underway to ensure that we are able to evaluate the hazard posed by volcanic tsunamis throughout the Pacific and around the world and to put in place systems to better protect people from this hazard.



Resolving landscape dynamics in the Fox Glacier/Te Moeka o Tuawe Valley with remote sensing and 3D-change detection

Ellorine Carle¹, Pascal Sirguy¹, Simon Cox², Saskia de Vilder²

¹Otago School of Surveying, Dunedin, New Zealand, ²GNS Science, Lower Hutt, New Zealand

Concurrent 1a, Hunua 1, September 4, 2023, 10:30 AM - 12:30 PM

The Fox Glacier/Te Moeka o Tuawe catchment, located in the West Coast region of Te Wai Pounamu/South Island of Aotearoa/New Zealand, experiences persistent landscape evolution by landslides, glaciers, tectonic forces, and precipitation. Signs of increasing instability of ice and sediment in the catchment include the rapid recent retreat of Fox Glacier since 2008, heightened erosion across numerous paraglacial hillslopes, and widening of the river's margins. Increased landsliding and rockfall have irreparably damaged the valley's access roads and present significant hazard to travelers in the valley, the nearby township, and road infrastructure. Quantifying changes in this area is therefore important to advancing understanding of landscape evolution and processes, particularly given climate change and anticipated near future Alpine Fault rupture.

Given the catchment's largely inaccessible, hazardous, and vast terrain, operational and emerging remote sensing techniques provide a means to study landscape changes in the area efficiently and comprehensively. The present study takes advantage of a six-year time series of high resolution digital surface models and imagery captured between 2017-2022 to quantify 3-D landscape change and characterise numerous geomorphological phenomena including:

- 1) evolutions of several large, creeping landslides in the Fox and Victoria Valleys
- 2) retreat of the Fox Glacier and subsequent gradual failures of adjacent hillslopes
- 3) accretion in the riverbed and channel widening in response to increased landslide- and glacially-driven mass wasting



The role of ecosystem services in restorative marine economies

Dr Emily Douglas¹, Andrew Lohrer¹

¹National Institute of Water and Atmospheric Research Ltd (NIWA), Hamilton, New Zealand

Concurrent 1b, Hunua 2, September 4, 2023, 10:30 AM - 12:30 PM

A restorative economy (RE) is a melding of environmental restoration and business activities, with tight interactions and feedbacks between them contributing positively to multiple societal well-beings. Ecosystem Services (ES), which can be used to document and quantify the benefits of healthy functioning ecosystems, are likely to be crucial to the success of RE in the scoping and planning phases, and as metrics of success while underway. Describing and quantifying whole 'bundles of benefits' delivered by healthy intact ecosystems will help to draw attention to the value of conservation and restoration. RE focused on single services such as carbon sequestration may be problematic in the marine environment given that our oceans are 'commons' without clear definitions of ownership.

This talk will focus on the role of ES in restorative marine economies, with examples from New Zealand where indigenous cultural values and rights require consideration. To de-risk investment and secure financing for RE, better quantification of ES and the development of multiple well-beings frameworks (encompassing social, ecological, cultural, and financial benefits) will likely be required. This will also promote effective communication and monitoring of the multiple benefits obtained from restored ecosystems, which will ultimately serve to sustain and expand RE endeavours.



Establishing a blue carbon methodology for Aotearoa New Zealand

Dr Phoebe Stewart-Sinclair¹, Dr Richard Bulmer

¹Niwa, Hamilton, New Zealand

Concurrent 1b, Hunua 2, September 4, 2023, 10:30 AM - 12:30 PM

In the face of the alarming climate crisis, several countries have agreed and committed to transition to a low-emissions economy. Aotearoa New Zealand has pledged to undertake efforts to mitigate the climate crisis and achieve New Zealand's carbon budgets, which will require a reduction in greenhouse gas (GHG) emissions. One alternative to reduce emissions is to increase carbon storage and sequestration in marine coastal ecosystems, known as 'blue carbon.' Increases in blue carbon can be achieved through restoration of marine coastal habitats. Restoration activities under a blue carbon initiative could be funded by generating carbon credits under the Emissions Trading Scheme.

An agreed-upon carbon accounting model will need to be developed to calculate the amount of carbon abatement provided by blue carbon projects. While the Australian Government has recently approved a methodology for calculating carbon abatement from restoration of marine coastal ecosystems for carbon credits, at present, there is no accepted framework for incorporating blue carbon into New Zealand's carbon market. Here, we adapt this methodology to apply to the New Zealand environment and policy context. We identify which components of the Australian Government's methodology align with a New Zealand setting, and which components will require modification.

Preliminary results suggest that default values for emissions from current land uses are broadly comparable, while values for restored marine coastal ecosystems need to be revised to account for differences between the Australian and New Zealand marine coastal environments. Developing a framework for incorporating blue carbon projects into New Zealand's carbon market will be a crucial tool to reduce emissions and meet international commitments.



Advocating for marine biodiversity, one squid at a time

Dr Kat Bolstad¹, Dr Heather Braid¹

¹Auckland University of Technology, Auckland, New Zealand

Concurrent 1b, Hunua 2, September 4, 2023, 10:30 AM - 12:30 PM

Taxonomy underpins all other biological research, yet an estimated 85% of our extant species remain without names or formal recognition in the Linnaean system. Accurate identification and classification of Earth's changing biodiversity and zoogeographic patterns rely increasingly on 'integrative taxonomy', supported by multiple lines of evidence (such as physical features and DNA).

Our women-led research group, informally known as the 'AUT Squid Squad,' trains young researchers in integrative taxonomy, with a focus on deep-sea cephalopods (including giant and colossal squids), as well as teaching taxonomy and biodiversity at the undergraduate levels. We'll share stories of discovering new species, poking through whale stomach contents, smuggling a giant squid onto a ferry, and the wider adventure of managing deep-sea research careers alongside family life, as we battle the global 'taxonomic impediment' to further humans' understanding of—and appreciation for—squids and biodiversity in general.



Re-orienting preservice chemistry teachers towards sustainability through systems thinking for environmental restoration

Prof Ruby Hanson¹, Mr Charles Hanson²

¹University Of Education, Winneba, Winneba, Ghana,

²Kwame Nkrumah University of Science and technology, Kumasi, Ghana

Concurrent 1b, Hunua 2, September 4, 2023, 10:30 AM - 12:30 PM

Chemistry education is expected to holistically integrate science and society so that knowledge is constructed and owned in a pragmatic manner for learners to be able to sustain the ecosystem and solve humanitarian challenges in a holistic manner. In an attempt to institutionalise chemical concepts and drivers of environmental restoration, education must be geared towards the principles of sustainability through systems thinking to mitigate humanitarian challenges.

Sustainability and systems thinking behaviour can best be demonstrated by a sustainable literate society. The development of such a society is very vital for teacher training institutions as education is touted as the prominent key to development. Chemistry education must, therefore, be packaged in a manner for learners to acquire the literate content knowledge and skills to conserve resources for posterity, environmental and personal safety as well as mitigate existing and future humanitarian challenges through systems thinking. Literature shows that many teacher education training programmes have paid little attention to the training of teachers in this regard.

This presentation is a discourse on the knowledge base and instructional plan that is necessary for teaching sustainability from a systems thinking approach for the restoration of the natural environment.



Water security under Te Mana o te Wai

India Eiloart¹

¹Taumata Arowai, Te Whanganui-a-Tara, New Zealand

Concurrent 1b, Hunua 2, September 4, 2023, 10:30 AM - 12:30 PM

Ko te wai te oranga o ngā mea katoa
Water is the life giver of all things

Water security is an immediate threat to all people and environments across the world, and Aotearoa New Zealand is no exception. However, we have the unique opportunity to approach this challenge equipped with the fundamental concept of Te Mana o te Wai. This approach draws on te ao Māori (Māori world) perspectives to recognise the whole-of-system approach to wai (water), from maunga (mountain) to moana (sea) – ki uta ki tai.

Water security encompasses the policies and management practices that enable “the availability of [water] in sufficient quantity and quality to ensure socio-economic development, livelihoods, health and ecosystems” (World Water Council, 2021). Nations must consider the availability and quality of water for the health of their people, their environment, and future generations. Te Mana o te Wai places the intrinsic value of water first, because by protecting the health and well-being of our freshwater we protect the health and well-being of our tāngata (people) and taiao (environment) (Ministry for the Environment, 2020).

Te Mana o te Wai has recently been recognised by the water industry as essential to the sustainable management of this precious resource in Aotearoa. It connects different regulatory regimes through a common vision and set of principles. The Ministry for the Environment incorporated Te Mana o te Wai into the National Policy Statement for Freshwater Management in 2014, and it has since been acknowledged as the central concept for freshwater management. Te Mana o te Wai was then embedded into the legislative foundations of Taumata Arowai – the dedicated water services regulator for Aotearoa. It is the future of wai, and therefore the future of Aotearoa New Zealand.

Wai ora. Tangata ora.
Healthy water. Healthy people.



Using bacteriophages to enhance global health: a drug delivery system that could revolutionize cancer prevention in low-income nations

Ms Daliya Rizvi¹

¹Affiliation for this project not finalized yet. However, in the past, I have worked with the Sindh Institute of Urology and Transplantation and Georgetown University Medical School, and have worked independently on various projects, Vienna, United States of America

Concurrent 1c, Waitākere 3, September 4, 2023, 10:30 AM - 12:30 PM

Bacterial biofilms can cause infections directly, and can also serve as catalysts for chronic illnesses such as colon cancer. The success of phage therapy in combating bacterial biofilms has been limited to easily accessible areas, such as the mouth. It has been a challenge to safely provide phage therapy to patients with biofilms in areas like the colon. The purpose of this research is to propose a novel approach to phage therapy for use in several contexts, particularly within the scope of colon cancer. This research focuses on the development of a genetically enhanced recombinant bacteriophage for use in an oral microneedle-based drug delivery mechanism.

In preparation for the study, sequencing analysis was performed for e.coli K-12, enterobacteria virus T3, enterobacteria virus T7, and enterobacteria T4 using the PATRIC bioinformatics database. A genetic sequence for an enhanced recombinant bacteriophage (T3-T7-T4 hybrid) was developed. This recombinant exhibits a broader host range, as described by Lin et.al in 2012. It may also target multiple phage protein receptors when assembled through enzymatic reactions in vitro. We will isolate trained phage DNA using methods outlined by Jakočiūnė and Moodley in 'Methods and Protocols' and develop a membrane-bound drug delivery system using an ingestible polymer and ingestible proteins derived from silk, as described by Kim et.al (2020). Cryopreserved phage DNA will be inserted into the system, and the system's pH-sensitive coating will dissolve automatically once a biofilm is detected.

This system, once developed, will allow for the delivery of phage DNA directly to areas of the colon where biofilms are prominent. This solution has the potential to become a cost-effective preventative approach for several forms of internal cancers that originate as a result of inflammation and oxidative stress caused by bacterial biofilms. If implemented properly, it could become a strong agent for healthcare equity.



The yin and yang of alveolar bone remodelling

Dr Trudy Milne¹

¹Sir John Walsh Research Institute, Dunedin, New Zealand

Concurrent 1c, Waitākere 3, September 4, 2023, 10:30 AM - 12:30 PM

The prevention of alveolar (jaw) bone loss is a common theme within the discipline of dentistry. The discovery and characterization of three key players in bone homeostasis, the cytokine receptor-cytokine-decoy receptor triad formed by receptor activator of nuclear factor kappa-B ligand (RANKL), receptor activator of NF- κ B (RANK), and osteoprotegerin (OPG) highlighted the regulatory relationship that exists between bone and immunity.

Periodontitis is a bacterially-induced inflammatory disease, caused by a dysbiotic microbiota resulting in damage to the tooth-supporting tissues and alveolar bone resorption. Osteoclasts (bone resorbing cells) originate from cells of the myeloid lineage. These circulating myeloid cells in the presence of M-CSF and RANKL, differentiate into RANK-receptor expressing pre-osteoclasts which proliferate and fuse to form multinucleated osteoclasts capable of resorbing bone. OPG is a circulating inhibitor/decoy receptor of RANKL which can inhibit osteoclastogenesis preventing bone resorption.

Associated with periodontitis is the initiation of an inflammatory response. Inflammation results in activation of the JAK/STAT pathway by IL-6 and/or IL-17. This in turn activates RANKL expression stimulating activation of osteoclasts and bone resorption. The ability to modulate these two inflammatory mediators would allow for the control of the inflammatory response.

Grafting material is often used to fill empty sockets following tooth loss to maintain alveolar ridge volume prior to implant placement. Analysis of tissue from a sheep tooth socket extraction model filled with the bovine-derived xenograft Bio-Oss found no difference when compared to an empty socket left to heal naturally. OPG, RANK and RANKL protein and mRNA were found to be expressed at similar levels, and although not osteogenic, the grafting material appears to offer osteoconductive properties.

With a goal to furthering our understanding of alveolar bone remodelling with regard to the RANKL/RANK/OPG cytokine triad our findings will be presented.



Optimising Probiotic delivery systems to withstand the rigors of commercial food processing, long shelf-life storage and delivery to the body

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¹Fonterra, Palmerston North, New Zealand

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Due to the growing body of evidence around the role of the gut microbiome on human health and wellbeing, probiotics are seen as an increasingly important contributor to the wellness solution. The global probiotics market continues to grow and will achieve a size of USD 111 billion by 2030 from a predicted CAGR of 7.5% from 2021 to 2030. Globally, significant research and development investment continues for health research into new strains of probiotics. However, most probiotics for human consumption are in capsule or ready to mix dry powders formats as it allows a safe environment to economically add an efficacious dose of probiotics.

Probiotic addition into ready to consume foods and beverages has not been achievable for the vast majority of probiotic strains due to three significant stability challenges.

1. Shear and heat stress often required to make and preserve food for long storage is detrimental to the stability of probiotics.
2. Higher water activity food environments for long storage at ambient temperatures, which is required for global supply chains.
3. Survival through digestion and release at an efficacious dose.

Globally food innovators are now researching solutions to these problems as this will unlock a whole new way of delivering the health benefits of probiotics. In this talk, we present work that is ongoing at Fonterra Research & Development Centre for the development of solutions to probiotic stability in foods and beverages that are commercially relevant and that are delivered at an efficacious dose that will deliver human health benefits.



Antimicrobial graft materials for bone engineering

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Infection after bone grafting in dentistry and orthopaedics is clinically challenging to treat. This research aimed to investigate the safety and efficacy of mānuka oil and silver nanoparticles (AgNPs) as non-antibiotic antimicrobials for inclusion in grafting materials.

Mānuka oil was tested for antimicrobial activity on seven species. Biocompatibility was assessed with primary human gingival fibroblasts (HGFs) and cell viability, cytotoxicity and caspase 3/7 production measured. Emulsions were produced with mānuka oil, carrier or chlorhexidine and their rheology assessed along with effects on *S. gordonii* biofilms. Lipoic acid-capped AgNPs were synthesised. Antimicrobial activity was tested on six species. Cell viability of osteoblasts (Saos-2) and osteoclasts (RAW 264.7) was investigated in the presence of AgNPs and TEM and qRT2-PCR performed.

Mānuka oil had a minimum bactericidal concentration of $\leq 0.1\%w/w$. HGFs showed significantly reduced viability with exposure to mānuka oil but significantly less than for chlorhexidine. Caspase 3/7 was elevated at 6 hrs for 0.1% mānuka oil. A composition of 5% manuka oil, 15% rice bran oil, 40% surfactant and 40% water had suitable rheology and was more antimicrobial than a 2% emulsion of chlorhexidine. AgNPs were antimicrobial with $\leq 12.5 \mu\text{g/ml}$. Cell viability assays showed osteoclasts were more susceptible to AgNPs than osteoblasts. TEM detected AgNPs both as nano-particles and nano-chain assemblies within the cytosol of cells. AgNPs resulted in 28 significantly regulated genes with HMOX1 (86-fold upregulation) as a hub gene.

Mānuka oil was successfully included in an emulsion with antimicrobial activity. Its cytotoxicity on cells was lower than chlorhexidine and at high doses induced apoptosis. AgNPs particles were sequestered within cells via autophagy. AgNPs induce HMOX1 as a hub gene which acts as a protective anti-apoptotic protein. Mānuka oil and AgNPs show promising antimicrobial activity for bone engineering.



Portable electroantennograms – working towards a cyborg

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Portable electroantennograms (pEAG) can complement lab-based electroantennogram tools and unlike lab-based models have the potential to further our understanding of odor plume dynamics in an open-field situation. Essential questions such as the influence of plume structure on insect behaviour, the active space of semiochemical baited traps, and the impact of biotic and abiotic factors on this active space have not yet been fully addressed.

Challenges associated with pEAG include their miniaturisation and sensitivity, confounding environmental odors, and processing of data. Here, we report the development of a pEAG that is portable (both light weight (516g) and smaller (12 x 12 x 8cm, volume 1152cm³)) than earlier models, is able to incorporate insects of a range of sizes (4 to 30 mm antennal length), has wireless communication (communication range of 600m urban, 10km line of sight), a standalone power supply, and dual-channel antennae. This device has conducted comprehensive testing in large scale wind tunnels and preliminary trials in open air have begun. This pEAG is a promising first step towards the realisation of a myriad of new opportunities for future real-time analysis of in-field pEAG responses that can contextualise results from previous laboratory studies.



Emphasizing universities' innovation to achieve sustainability for smart cities mission in India

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Concurrent 1e, Waitākere 2, September 4, 2023, 10:30 AM - 12:30 PM

About 55% of the world's population lives in urban areas and it is expected to grow to 68% by 2050 which will be highly concentrated in a few countries, with India leading the list with the projected addition of 416 million urban population (UN, 2018). As per the global trend, the Government of India has also designated 98 smart cities to manage them more efficiently with technology. While the definition of a Smart City is ambiguous and evolving, the UN's Sustainable development Goal -11 talks about making cities and human settlements inclusive, safe, resilient, and sustainable. In this background, the paper through Spearman's Rank correlation shows that economically developed states of India may not be sustainable. So, there is a need for special attention to sustainable innovation for Smart Cities.

Recent experiences of reverse migration, job loss, hardship, and stress among families and women during the pandemic COVID-19 and innovative use of technologies as preventive and supportive methods such as Drone surveillance, e-teaching, e-meeting, etc. have shown the way that continuous innovation of sustainable technologies is the only way to survive during the period of climate change.

The continuous demand for technology can be met by engineering colleges which have grown exponentially in the recent past. However, from the study of the engineering colleges of Delhi, it can be said that they are not concentrating their innovation on the development of smart cities. They need to take clues from the 'living lab' experience of Barcelona where engineering colleges and universities play a very central role in the framework of the smart city. The students also need to know about the special needs of marginalized groups of people or women for their security etc.



Predicting fruit quality using the mechanistic model

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Concurrent 1e, Waitākere 2, September 4, 2023, 10:30 AM - 12:30 PM

High-quality fruit leads to better economic returns and reduced food waste and provides improved health benefits when consumed by people. Quality of fruit at harvest is determined by factors including nutrients and water the tree can supply and environmental conditions. Adverse factors can be seen in the fruit postharvest and during the storage stage. Therefore, our aim is to develop a digital twin model of apple growth on Future Orchard Planting Systems that simulates what happens from fruit set through to postharvest under certain circumstances. It will allow for effective postharvest care, less waste, and even greater consumer satisfaction. This ongoing study is to track the growth of apples to obtain data to train a digital model to predict the lifecycle of the fruit until postharvest and subsequent storage.

We selected 'Royal Gala' as our model cultivar because of its tendency to experience rapid textural degradation in storage. Additionally, its global popularity makes it suitable for replication in other studies if needed. We are collecting data such as fruit dry matter, soluble solids concentration, and firmness while they are growing. These measurements are typically used to track fruitlet development on the tree. We then use these assessment data together with weather data to train a mechanistic fruit development model. The model output options include dry matter, weight, volume and soluble solids concentration. Our current model predictions are close to the trends exhibited by our observation data.



Multi-omics integration pipeline - a test framework to analyze multiple high dimensional biological data.

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Concurrent 1e, Waitākere 2, September 4, 2023, 10:30 AM - 12:30 PM

In recent decades, the explosion of new technologies that measure cell contents or states across different omics layers, combined with a reduction in processing costs, has enabled a shift towards a holistic approach to the study of biological organisms. This multi-omics integration pipeline is a test framework designed to integrate data from multiple sources, such as genomics, transcriptomics, proteomics, and metabolomics, to gain a better understanding of the underlying biological processes.

The pipeline is composed of several steps, including different options for data pre-processing and feature selection, and facilitates the use of several integration tools. It also provides helpful visualizations to assess and interpret the results from each tool. Furthermore, it is extensible and reproducible, allowing users to add additional steps or modify existing steps as needed.

The aim of this testing framework is to systematically evaluate and compare existing tools for multi-omics data integration, in order to inform future integration analyses and promote best practices. In this talk, we will discuss our ongoing effort to construct this testing framework for multi-omics data integration.



Experimental monitoring system of canopy health and environment using IoT technology for deployment in remote sites

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Concurrent 1e, Waitākere 2, September 4, 2023, 10:30 AM - 12:30 PM

We present the prototype of a sensor system for monitoring the micro-climate in forest canopies with applications to red needle cast disease detection. The system is specifically designed to address the constraints of operating sensors in a forest environment and streaming data from remote areas. It consists of low-power, low-cost Internet-of-Things (IoT) devices connected to environmental and physiological sensors. Each device wirelessly communicates at a 10-minute intervals to a gateway that relays data to the internet for storage and analysis.

An experimental design for deploying the sensor system is proposed to study disease outbreaks in planted forests. In the future, similar systems can support the next generation of sensor networks for growth impact monitoring and disease warning systems.



Scale up and automation of *Pinus radiata* somatic embryogenesis

Dr Jana Krajnakova¹, **Dr Taryn Saggese¹**, Cathie Reeves¹, Sam Davidson¹, Celine Mercier¹

¹Scion, Rotorua, New Zealand

Concurrent 1e, Waitākere 2, September 4, 2023, 10:30 AM - 12:30 PM

The New Zealand commercial forestry industry has made large investments over many years to develop elite germplasm of radiata pine by means of different breeding strategies with the aspiration to populate our commercial forests with those trees that create the best value for the industry.

Recent advances in tree biotechnology, including somatic embryogenesis (SE) have enabled the development of more flexible tree breeding, with genomic selection and deployment strategies, than conventional seed orchard approaches can offer. Although SE has many advantages over other clonal propagation methods, the largest hinderance to a cost-effective process for plant production from SE lies in the tedious manual processes involved.

Scion has been working on the automation of somatic embryogenesis in the frame of the research programme 'Tissue culture for the 21st century forests' with international collaborators from Georgia Tech (USA) and Luke (Finland). The technology is based on the use of temporary immersion (TIM) bioreactors for the scale up of proliferation and maturation of embryogenic tissue, an artificial intelligence powered fluidics system for harvesting and selection of good quality somatic embryos, and a robotic deposition system for germination.

In this presentation we will provide an overview of the project, discuss our experiences to date with TIM bioreactors, present improved germination protocols aiming to streamline the process, as well as the development of machine learning approaches to allow for automation of embryo selection.



Holmes Solutions use time and motion studies to make sure products and processes are efficient and economical.

Miss Madeleine Burrows

Concurrent 1e, Waitākere 2, September 4, 2023, 10:30 AM - 12:30 PM

Time, material, and labour costs are some of the biggest problems the construction industry face. With material and labour costs soaring, it is important to think about construction efficiency from the start of the design process.

At Holmes Solutions, we use time and motion studies as an effective tool to review products and installation processes. These studies help identify areas of wasted time/effort and highlight possible improvements.

For these studies, we work with clients to figure the data they need and the best way to collect it. Once we've identified key tasks and equipment required, we run simulations to gather quantitative and qualitative data. We often run a number of studies, comparing different products/processes to show inefficiencies and compare design options. The data can be used to inform design decisions and streamline processes making them more efficient and economical.

In a real-world example, we used time and motion data when developing mass timber building connectors. The data helped us understand the tolerances, impacts and risks of current designs and assembly processes. Our innovation team used time and motion data in every stage of the development. The result was a new range of mass timber connectors that save up to 50% of installation time.

By targeting cost-effective solutions, time and motion studies also drive sustainable product design. This will help lead us to a more socially responsible and environmentally friendly industry.



Factors that influence young women to pursue their career in STEM in New Zealand

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Concurrent 1f, Hunua 3, September 4, 2023, 10:30 AM - 12:30 PM

There needs to be more research available to determine the factors that affect young women in NZ pursuing STEM careers. This paper conducts a thematic analysis of survey responses from 119 young women currently enrolled in a STEM-related course at Auckland University of Technology.

A literature review was first conducted to identify the emerging factors from the current literature focusing on the population outside of New Zealand. These themes and factors were further analysed in the literature related to the New Zealand population. The pre-collected survey data were analysed through quantitative and qualitative analysis. The survey results were then compared to the results from the literature review to identify the essential factors that mainly affect young New Zealand women pursuing STEM careers.



Shaping the future through contemporary approaches to engineering education

Dr Marlene Kanga AO¹

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Concurrent 1f, Hunua 3, September 4, 2023, 10:30 AM - 12:30 PM

The UN Sustainable Development Report, 2019, recognized that science and technology are key levers to advance the UN 2030 Agenda for Sustainable Development. With just 8 years remaining, engineering technology is advancing quickly to address issues such as climate change, food security, improved health outcomes, especially during the pandemic, access to reliable clean water and sanitation, and energy. This has been and will continue to be the work of engineers.

But technology alone will not deliver the changes we need. We need a paradigm shift in the way technology itself is developed and how the benefits are shared across the world, especially beyond 2030. This will require an increase in the capacity and capability for engineering and technology and equity of access and agency for underrepresented groups including women, young people, the rural poor, many in developing countries.

Enabling more engineers, especially women, with the right skills in these countries is, therefore, key to ensuring our futures in a rapidly changing technological world.

This presentation will discuss contemporary approaches to ensure quality engineering education through; leadership initiatives by the World Federation of Engineering Organizations (WFEO) in partnership with UNESCO, INWES, and other international organizations in STEM. The presentation will provide unique and valuable insights into the changes that have been made, the imperative for them, and their expected global impact.



The Aotearoa New Zealand longitudinal gender attitudes survey

Suzanne Manning¹

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Concurrent 1f, Hunua 3, September 4, 2023, 10:30 AM - 12:30 PM

Te Kaunihera Wāhine o Aotearoa – The National Council of Women of New Zealand (NCWNZ) have partnered with Research NZ for six years to monitor the attitudes to gender of a representative sample of New Zealanders. The survey has been run every two years since 2017, and the 2023 results will be released just before the ICWES19 conference. The survey asks questions around attitudes to gender equality as a right, to the gender-appropriateness of different things such as occupations or personal attributes, to gender-based violence, and to diversity in gender and sexuality. The 2021 survey, for example, found that 24% of respondents felt that the occupation of ‘Engineer’ was more suited to men than women (compared with 20% in 2019 and 19% in 2017). It remains to be seen if 2023 will reverse this increasingly gender-stereotyped trend.

This presentation will summarise the results of the 2023 gender attitudes survey and discuss the initiatives that NCWNZ are taking to shift attitudes within society.



Creating a center for STEM excellence in New Mexico – the power of STEM advocacy at the State Government Level in the USA

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¹Society of Women Engineers, Santa Fe, USA

Concurrent 1f, Hunua 3, September 4, 2023, 10:30 AM - 12:30 PM

The numbers of women and minorities graduating with degrees in engineering and computer science in the USA have remained stubbornly low, roughly 21%, with little progress in three decades. SWE has ramped up STEM advocacy in the USA at the national level over the last 10 years; and holds an annual Capitol Hill Day in Washington, D.C. that has achieved some success in passing federal legislation aimed at improving STEM education access for women as well as the climate for women in engineering. SWE has encouraged its members to expand into grassroots STEM advocacy at the state and local levels, which has the potential for more impact in less time than federal advocacy efforts.

This presentation will describe how the authors and other members of the Central New Mexico Section of SWE have been working with state officials to introduce legislation that would create a Center of Excellence in STEM for the State of New Mexico. It will include insights and tips on how to work with state [local, district or provincial] legislators and their staff to draft the legislation and how to develop and conduct training for organizational members to advocate for the legislation that can be adapted to other legislative environments.

The concept for the STEM Center of Excellence includes a centralized repository for all STEM-related programs K-16 that can be accessed throughout the state; an executive director and staff to set strategic direction, maintain databases, evaluate the efficacy of programs, communicate with regional partners throughout the state, and help promulgate successful programs to those partners. The bill also proposes an executive advisory council to include educational institutions, representatives from major industries and employers, and a variety of non-government organizations like SWE who sponsor and manage STEM programs throughout the state.



A novel approach to analyse continuous microchemical information from biological samples reveals changes in migration and habitat-use patterns of snapper (*Chrysophrys auratus*)

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Biological samples such as bones accrete over time and certain trace elements recorded in them reflect the environments in which the organism lived in. Fish otolith as a calcified structure in the fish's inner ear, records continue elemental imprint of waters through accretion of calcium carbonate. Like a movement trajectory, the time-series of chemical signatures extracted from otolith samples are temporally autocorrelated. This allows us to retrospectively position individual fish in space and time throughout their life and make inferences about early life (e.g., nursery) habitat use patterns during ontogeny - independent of confounding metabolic factors.

We used a novel approach coupling inferential behavioural models and hierarchical clustering with fish otolith microchemistry to analyse continuous life history information independent of climate and physiological variability. By comparing archaeological snapper otolith samples with modern day fish, we found that pre-industrial (1430–1640 CE) land use and fishing practices had little influence on the well synchronized migration behaviour of juvenile snapper *Chrysophrys auratus* in the Hauraki Gulf, New Zealand. In contrast, modern human disturbances have resulted in snapper spending less time in brackish nurseries and moving chaotically between habitats.

Our results shown that today, nearshore habitats have largely lost their nursery function for the species. Using this approach, we have demonstrated a high-resolution assessment of interactions between fish and habitats by applying novel time-series analysis on otolith samples, and provided detailed insight into snapper early life history and ecosystem dynamics.



The fight against myrtle rust

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Concurrent 2a, Hunua 1, September 5, 2023, 12:45 PM - 2:45 PM

Myrtle rust is a globally devastating plant disease of the myrtle family called by the pathogen *Austropuccinia psidii*. The pathogen was first found in Aotearoa New Zealand in 2017 and since then has spread across the country. There are around 13 native species of myrtles in Aotearoa, these include the iconic pōhutukawa, mānuka and rātā. The disease is already causing localised extinction of our most susceptible native myrtles, ramarama, rōhutu and their natural hybrids.

Here the status of myrtle rust in Aotearoa is reviewed, this includes the susceptibility of our most vulnerable native myrtles, along with potential management and control options for the disease.



The footprint of ship anchoring on the seafloor

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With the SARS-CoV-2 coronavirus came what media has deemed the “port congestion pandemic”. Since it began, thousands of ships have been reported waiting outside heavily congested ports relying on anchoring gear to hold fast. While the shipping industry is known to contribute to air, water and noise pollution, the physical impact of shipping practices, such as anchor use on the seafloor, has received much less attention.

With a regional survey using high-resolution (1 m) bathymetry data of a comparatively low congestion port in New Zealand-Aotearoa, we demonstrate that high-tonnage ship anchors excavate the seabed by up to 80 cm and the associated impacts are preserved for at least 4 years. This is the first characterisation of the intensity and extent of damage to the seafloor and benthic environment caused by high-tonnage ship anchoring. We demonstrate that the observed seabed damage is attributed to high-tonnage passenger and cargo vessels. Anchor use in port regions has significantly changed the structure of the seafloor, with downstream impacts on benthic habitats and ecosystem functions.

Extrapolating these findings to a global scale, we estimate that between 6,000 and 20,000 km² of coastal seafloor is adversely affected. With the predicted increase in global marine traffic, a less destructive method of managing high-tonnage vessels awaiting port calls is necessary to mitigate the impact of maritime activities on chemically and biologically important shallow marine environments.



Oceanographic baseline at a future offshore fish farm site in Cook Strait

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Environmental limitations render the expansions of fish farming in shallow coastal waters unsustainable, and global efforts are now underway to explore opportunities offshore. Fish farms placed offshore, in deeper and more energetic water, are expected to have a lesser impact on the seafloor ecosystem because they i) disperse organic waste widely, which decreases the amount settling per unit seafloor area, ii) extend the time that waste can be degraded before settling at the seafloor, and iii) decouple the quality of the seawater in the fish pens from waste degrading biogeochemical processes at the seafloor. A social licence for offshore fish farming, however, will require the farmers to quantify these advantages with environmental monitoring. Suitable protocols for monitoring the offshore seafloor are not yet established but currently developed based on seafloor lander technology.

Here we present the first lander-based in-situ measures of pre-farming baseline conditions at a future offshore farm site in ~86 m deep water off Pelorus Sound, in the Cook Strait, New Zealand. We deployed two landers, a mini-chamber, and an eddy covariance lander, to measure the total seafloor oxygen demand, near-bottom currents, and water column profiles of seawater temperature, conductivity, oxygen, and turbidity.

Our repeated measurements show strong near-bottom currents during each tidal cycle, evidence for particle resuspension events, and general agreement between the two lander-based estimates of the seafloor oxygen demand. We will discuss these results and the need for additional measurements, which will complete our baseline and improve our understanding of how the hydrodynamics at this site will influence the future response of the sedimentary ecosystem to organic loading.



Seafloor cold seeps offshore Aotearoa – geologically controlled oases of life under threat?

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Seafloor cold seeps are abundant along Aotearoa New Zealand's Hikurangi Margin, and support dynamic, highly productive local ecosystems with chemosynthetic fauna (e.g., those that use methane gas as their food source). These seeps are predominantly located along the crests of seafloor ridges that have formed due to processes related to plate subduction. The structural complexity underlying these seeps results in hot spots of food production and diversity which may support commercially important fisheries species, such as those targeted by bottom trawlers.

Research over the past two decades has shown that many of the species identified at these seeps are new to science and/or endemic to Aotearoa. Many of the cold seeps are directly related to subseafloor gas hydrate accumulations, which are only stable under certain pressure and temperature conditions. Many seep fauna are extremely slow growing, and seep communities will take years to millennia to recover from disturbance. Significant impacts to these sensitive seep ecosystems are likely with coupled anthropogenic activities (e.g., fisheries and gas or hydrate exploitation) and increasing environmental pressure from future sea level rise, ocean warming and deoxygenation.

Data acquired over the past five years have revealed the geological complexity underlying these seep sites, and further highlighted locations where humans have already impacted the seabed. We contrast seep sites across different water depths and localities along the margin to assess the vulnerability of these seabed habitats to potential future disturbances. The results demonstrate the criticality of both marine environmental planning, and underpinning geological understanding, to ensure the sustainability of human activities in the oceans around Aotearoa.



Predicting macroalgal range shifts in Aotearoa New Zealand to inform climate-smart conservation management

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Rocky reef habitats in Aotearoa New Zealand are characterised by habitat forming macroalgae which differ between the sub-tropical North Island, and the temperate South Island due to oceanic currents, latitude and geographic isolation. Throughout New Zealand, localised extinctions of large canopy-forming species have occurred due to increasingly frequent and severe marine heatwaves and long-term sea temperature rise. These key ecological communities may become homogenised, with disturbance tolerant generalists and range expanding warm-water species replacing threatened endemics. Ecosystem management plans should consider these community turnovers, given they could result in trophic cascades and large-scale biodiversity loss.

This research aimed to develop quantitative knowledge on where and how community shifts will occur and apply this to identify target areas that maintain temporal species protection. We use a large national macroalgae database of georeferenced long-term herbarium and survey data, combined with fine-scale climate data to develop species distribution models for habitat-forming algae around coastal New Zealand. We predict current and future distributions for 2050 and 2100 using projected environmental data. Using time-period specific distributions, we categorise distinct macroalgae bioregions with multivariate analyses, and use a dynamic conservation planning framework to explore region-based and species-based management scenarios.

Results suggest the species driving the bioregionalisation are predicted to change in distribution, altering the bioregion boundaries through time, with associated shifts in conservation priority areas. Our findings highlight the need to consider shifting species distributions across biogeographic transition zones to enhance long-term ecosystem management strategies.



Tackling Wicked food security problems: establishing an investment system to support amazing science for the future

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Concurrent 2b, Hunua 2, September 5, 2023, 12:45 PM - 2:45 PM

What will the world need in the future to keep feeding the global population? With more people moving to urban areas and less land for agriculture, how will we make sure we can provide the right foods for future generations? Five years ago within Plant & Food Research, we started thinking differently about how we tackle these 'wicked food security problems' by rethinking our approach to structuring and investing in research. Because although research has the amazing potential to change the world and shape our lives; this research doesn't happen without resources and the investment systems to support it.

Come and hear a tale from the other side, from a research manager who's spent the last 5 years designing and implementing a mission-led approach to research. Hear how we went from zero to \$40M of research activity aligned to our Ngā Pou Rangahau -Blue sky science for Growing Futures™ at Plant & Food Research (plantandfood.com). What did we do, how did we bring researchers along with us on this journey and what did we learn along the way?



Promotion of diversity and inclusion in STEM - some tips on improving Japanese situation

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According to an OECD survey, Japan had the lowest percentage of female teachers working at universities and other higher education institutions in 2020 among 32 comparable countries. In Japan, women's talents are not fully utilized and improvements are needed. Taking the Japan Institute of Light Metals as an example, the percentage of female students among the student members is high, but the percentage of female members drops sharply when they become full members.

Along with increasing the number of young women in science and engineering, it is important to establish systems and provide role models so that they can continue to pursue careers in science and technology after graduation. In order to expand the range of options and promote diversity and inclusion, we should abandon the stereotypical view that men are to earn outside and women are to do housework. A recent survey shows that this stereotype still persists in Japan.

In the presentation, will introduce the importance of showing role models and the elimination of unconscious bias along with examples from academic societies and universities to which I belong.



The changing face of women in STEM in Aotearoa New Zealand

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The New Zealand Association for Women in the Sciences (AWIS) was formed in 1986, primarily as a support group for women in the sciences. In the almost 40 years since its inception, AWIS has morphed its activities to meet the needs of women in STEM at any given time. In 2019, AWIS undertook a strategy refresh and rebranding exercise, which identified the areas on which the members of the volunteer organisation believed should be a focus – addressing bias, developing careers and ensuring work-life balance.

This presentation will delve into the changing statistics of women in STEM in New Zealand, reflect on the learnings gained during the strategy project, and share how AWIS is bringing them to life for its members.



Improving gender equality in forestry disciplines

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Gender equality in STEM subjects is a global issue and one the International Union of Forest Research Organisations (IUFRO) is actively tackling. While there are growing numbers of women in forestry fields, the discipline is still heavily dominated by men, which requires the need for supportive and inclusive environments to continue to grow female participation.

Researchers in the Forest Health division of IUFRO recently surveyed forest pathologist and entomologist professionals globally to better understand the barriers they have faced in their careers. We outline the findings from this survey along with the recommendations on how we can create more inclusive environments that are more welcoming towards women and other underrepresented groups. We also outline the initiatives underway and leadership changes that have been made to provide greater support and opportunities for women in IUFRO Forest Health.



Women in Space Aotearoa New Zealand: A professional network and supportive community taking action in pursuit of gender equity in Aotearoa's space sector

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In October 2021, a group of women working in the space sector in New Zealand, from across academia, industry and government, formed a new professional network aiming to support and enable women and gender minorities working in the sector, and to take steps towards achieving gender equity across the sector: Women in Space Aotearoa New Zealand (WISANZ). The network has since grown to over 100 financial members, and a mailing list over 400. We believe we are the first national women's professional network focused solely on the space sector.

The representation of women in the global space sector is a disappointing 20% across all roles, estimated less than 10% for technical roles – a proportion unchanged over 30 years. Women make up only 28% globally of STEM researchers.

In 1893 New Zealand led the world in women's right to vote. In 2018 Aotearoa became only the 11th state to launch into orbit. Five years later, Aotearoa's commercial space sector has expanded rapidly with companies at the global leading edge across a range of space technologies. Our companies and scientists are engaging in exciting global space developments and actively contributing to the new era of human space exploration.

WISANZ's ambition is to continue Aotearoa's proud history of leading on both gender equity and space innovations to again lead the world, this time in the achievement of real change in the representation of women in the space sector.

WISANZ is implementing initiatives to inspire the next generation of young space wāhine, and to support and enable women and gender minorities already working in the sector. As a collective, we are engaging constructively with government, industry and institutions to work together to both increase the number of women entering the sector, and to create work environments that welcome women and enable their success.



Fighting the labour shortage in the water industry: attracting and retaining immigrants and women

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¹GHD, New Zealand

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Aotearoa is facing a significant labour shortage in the water sector in 2022, with thousands of skilled workers needed in the next 30 years to achieve safe drinking water standards across the country (Water New Zealand, 2022). To date, the literature has not yet materially focused on better attracting and retaining women and immigrants in the water industry as a potential solution to help address this issue.

There is an increasing number of programmes to encourage girls to study STEM-related fields in New Zealand; however, the water sector is still strongly male-dominated. Moreover, there are documented challenges in retaining women who decide to work in this field. For example, Devonshire and Davidson (2020) demonstrate that women are more likely than men to leave engineering early in their careers.

Attracting and retaining skilled migrants is another ongoing issue. The government reforms of immigration policies should contribute to a greater in-flow of specialised labour in New Zealand. However, there is significant competition within the market, with employers vying to hire professionals when they arrive onshore. Furthermore, immigrants often experience a painful transition period when they start their first job and many employers may be poorly equipped to provide the level of support needed. This can lead to organisations risking losing new staff to other industries or countries. All of these factors contribute to the current workforce shortage.

This paper explores issues faced by women and immigrants and their experiences working in the New Zealand water industry. It also outlines a range of initiatives that could be trialled to attract and retain these key demographic groups, and to create environments in which a diverse range of people can thrive. The discussion draws on insights from quantitative and qualitative research with individual practitioners, and national and international studies and initiatives.



Functionalised wood-based materials for a sustainable built environment

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Carbon can be sequestered and locked in trees through CO₂ photosynthesis reactions, which contributes around 50% of the dry mass of wood. Therefore, better sustainable use of wood is critical for carbon capture and storage. An earlier study in New Zealand showed that a 17% increase in wood uses in the built environment has a direct impact on carbon emission by 20%. The estimation was based on using wood instead of brick, aluminum, and other building products that require more process energy than wood. With the increasing use of tall wooden buildings around the world, the environmental benefits of using engineered wood products (EWP) have been demonstrated extensively. For example, urban equilibrium has been defined as the situation where buildings act as a balancing agent for greenhouse gas emissions, therefore behaving as carbon pools.

Wood is a highly porous material with hierarchical cell wall structure that provides water transpiration and mechanical support functions. In recent years, here at Scion and around the world, emerging technologies have been developed in modifying and/or functionalizing wood and its cell wall with new functionalities. The presentation will cover, recent efforts including nanotechnologies on the achievements in wood structural design and engineering for the extension of carbon storage and replacement of fossil-based plastics.

Some of the shortcomings of wood and efforts made to overcome them will be discussed. Natural wood is subjected to crack, decay, aging, and dimensional instability, which leads to reduced service time resulting in returning carbon to the atmosphere. Wood preservation and modification techniques are applied to reduce the moisture content or alter the cell wall enabling prolonging its service time. An overview of the technologies for the development of wood products from the point of view of extending the service life and re-use/recycling will be presented and discussed.



Holmes Solutions develop Whoosh®, a personalised transport system on an elevated network of cable and rail.

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¹Holmes Solutions, Christchurch, New Zealand

Concurrent 2c, Waitākere 3, September 5, 2023, 12:45 PM - 2:45 PM

Whoosh® creates point-to-point transportation with autonomous electric vehicles that move along an elevated network of cable and rail. Cable sections are low cost and can span long distances over challenging terrain; rail sections allow vehicles to change direction and elevation. One of the unique features of Whoosh® technology is the ability to transition from cable to rail at speed. This allows vehicles to freely navigate the network and choose their own path.

Whoosh® uses electric vehicles with zero emissions and low energy needs. The energy requirements are 84% lower than typical bus or rail systems. Additionally, the embodied carbon in a Whoosh® transportation system is 184T of CO₂e/km. This is significantly lower than rail transportation which accounts for 941 (±168) T of CO₂e /km. The system is flexible and easy to implement in tight spaces. When existing structure is available, Whoosh® can use it to support the guideway, decreasing construction cost and disruption.

Holmes Solutions expanded the core technology of Whoosh® in 2019 during a prototype project with Google. The goal was to create dense corporate campuses with better connections to local communities. The project exceeded targets for usability, cost, sustainability, and speed to market.

We are currently advancing our Whoosh® technology and will be delivering a pilot project at Remarkables Park in Queenstown. In 2023, Whoosh® will help Remarkables Park reduce congestion and emissions, improve mobility, and save money.

In the future, Whoosh® will provide district-wide travel to airports, real estate developments, corporate campuses, universities, and resorts. Whoosh® vehicles will have capacity for 4-8 people and facilitate last mile solutions for goods and services. Global interest in Whoosh® continues to expand. We believe this innovative technology will revolutionise transportation.



Securing Aotearoa's sustainable housing future with indigenous knowledge: an exploratory study

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Concurrent 2c, Waitākere 3, September 5, 2023, 12:45 PM - 2:45 PM

Aotearoa, New Zealand, urgently needs affordable, better-quality homes that are highly energy efficient to support the transition to a climate-resilient economy. The building sector contributes 20% of NZ's GHG emissions, with 70% from construction and operation activities and 30% from embodied carbon. Currently, a single-detached house emits about 195tn CO₂eq over a 90-year lifetime. To reduce its carbon emissions to meet the Government's Zero Carbon 2050 goals, NZ new builds must achieve 35tnCO₂eq per new standalone.

The power of the indigenous worldview, when bridged to western science, creates innovative technologies that shape future science directions. Our exploratory study hinged on McFarlane's He Awa Whiria (Braided Rivers) model, which describes combining the strengths of two distinct worldviews (Mātauranga Māori and Western Science) into a "workable whole." The model brings together these two different paradigms as equals, incorporating both numerical and opinion-driven results.

We explored international case studies where indigenous knowledge has informed regenerative and sustainable housing systems across the globe. With the lesson learned, we examined the distinctive contribution of Mātauranga Māori and resources (Taiao), that, when conceived, planned and delivered in concert with the Māori community, provide a sustainable zero-carbon housing supply for New Zealand. In addition, we conducted a pilot questionnaire survey on 50 home users to identify their preferences for housing needs and design. With the findings from the literature review and questionnaire survey, we identified the symbolic indigenous pillars of a sustainable house, which biophilic zero-carbon house design must draw upon to reflect the knowledge, life experiences, and preferences of the average Kiwi.

This work is part of the main study for an affordable zero-carbon housing solution in New Zealand. Our study adds to existing knowledge of the importance of indigenous knowledge and resources to building better-quality homes that are comfortable, dry and warm.



African fermented seeds as probiotic carriers for poultry feed and an alternative to antibiotic growth promoters.

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Concurrent 2d, Waitākere 1, September 5, 2023, 12:45 PM - 2:45 PM

The use of subtherapeutic doses of antibiotics in poultry as growth-promoting agents has been implicated in the development of antimicrobial resistance. Probiotics have been recognized as suitable alternatives to antibiotics in poultry production. African Fermented seeds (AFS) have been produced by rural women in West Africa and are an affordable source of protein, flavor enhancer and source of income. Research has established that *Bacillus* species are the predominant microorganisms involved in their production.

In our study, *Bacillus subtilis* and *B. pumilus* groups were investigated for their antimicrobial and hemolytic activities, antibiotic susceptibility and acid and bile salt tolerance. *Bacillus* isolated from AFS were cultured at pH (2, 3, 4, and 7) and the optical density (OD₆₀₀) measured. The strains were also inoculated in 0.3% bile salts and OD at 600nm measured. The susceptibility of the isolated strains, to antibiotics was determined by testing against a range of antibiotic impregnated discs. All strains were observed to grow at pH 3 and below and were able to grow at 0.3% bile with OD₆₀₀ of up to 0.5 after 18 hours of incubation. The strains showed varying susceptibilities to the antibiotics tested with some showing resistance. Some strains were also seen to inhibit growth of *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *E. coli*. None of the strains exhibited complete hemolysis. 45% of the strains exhibited α -hemolysis and 55% were non hemolytic.

Probiotic bacteria should be tolerant to bile and low pH concentrations in the gut. The strains investigated were seen to grow well under these conditions. However, there is the need to be selective since some strains showed resistance to some antibiotics.

The findings from the study show the possibility of using probiotics from fermented seed condiments as a replacement for antibiotic use in poultry feed in sub-Saharan Africa.



The concurrent impacts of drought and leaf harvesting on two traditional African vegetable non-timber forest product species

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Investigating the concurrent impacts with harvesting on wild vegetables can guide their sustainable management while contributing to the understanding of such impacts on NTFP species. This study investigated leaf production, morphological and growth responses to the concurrent impacts of drought and leaf harvesting between two wild vegetables.

A randomized greenhouse experiment was implemented with 1,334 plants of *Amaranthus* sp. and 391 of *B. pilosa*. A drought treatment was first implemented through six levels of drought stress and a control treatment. The harvesting treatment consisted of four harvesting levels and was implemented twice. Measurements were recorded before first and second harvests and at end of experiment. Data were separated into two periods (after first and second harvests) and analyzed using Multivariate Analysis of Variance and log-linear analysis.

The results showed significant effects of drought on both species. However, *Amaranthus* sp. appeared more resilient to reduction in the daily amount of water than reduction in the frequency, while *B. pilosa* was resilient under both facets of drought stress. For *Amaranthus* sp., basal diameter, its growth, leaf production and survival increased with increase in the harvesting level (with some exceptions) after first harvest. After second harvest, there was decrease in plant height and leaf production. In *B. pilosa*, the impact was only significant on survival and leaf production (after first harvest). The effect of the interaction of the two drivers was significant for *Amaranthus* sp., but not for *B. pilosa*.

The results also highlighted the possible negative impact of a prolonged high rate harvesting on the species performance, especially under severe drought. Basal diameter, its growth, survival and leaf production appeared more resilient to reduced amounts of watering in *Amaranthus* sp., and under both types of drought stress for *B. pilosa*. This suggests that both species could be sustained under medium drought stress.



Closing the gap between liking and wanting - improving prediction of consumer behaviour through new methodologies.

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Concurrent 2d, Waitākere 1, September 5, 2023, 12:45 PM - 2:45 PM

A significant proportion of product launches fail. In the context of product development, product evaluations are key to predicting product success. The relationship between the consumer and the food has depth that goes beyond liking and preference alone. Understanding the emotional processing that motivates human behaviour provides an opportunity to capture the total product experience and thereby improve prediction of product performance and success.

Current methods for evaluating emotional responses to products such as Check-All-That-Apply (CATA) require direct, explicit responses from participants, relying on rational conscious thinking frequently described as System 2. However, it is understood that System 2 type thinking does not provide the complete picture for predicting actual consumer choice behaviour. It is hypothesised that this can be improved by combining the current explicit methods with tools that elicit the implicit, unconscious/intuitive responses of System 1.

The presentation will discuss the similarities and differences obtained when comparing two methods: CATA as the explicit emotional measurements to yoghurts vs Response Time Testing (RTT) as the implicit measure. This presentation will highlight their applicability to product evaluations and show that reported results from both test methods are aligned in the type of emotions associated with test of different yoghurts. In addition, the results show some insightful differences between CATA and RTT demonstrating that combining explicit and implicit methods will provide an additional layer to the understanding of the product experience.

The presentation will conclude with a future focused perspective on the need and challenges faced by food and beverage industries when willing to develop, validate and apply new emerging methods involving both intuitive and rational consumers responses to product sample evaluations with the goal to improve sustainable food consumption through improved prediction of consumer choice.



Beekeeping outside the box: innovative colony handling and hive architecture

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Traditional beekeeping practices were developed to support honey production and have remained relatively unchanged since the advent of the 'modern' beehive in the 1850s. In contrast, during that timeframe there have been tremendous changes in how crops that honey bees pollinate are managed. This disparity has resulted in tensions between beekeepers and growers, as beekeepers decide each year if they will dedicate their colonies to honey production or pollination.

Our data suggest that young colonies, establishing a new hive, may be better suited for efficient crop pollination than the mature colonies traditionally used for honey production and pollination. We are working with beekeepers and growers to develop practical strategies and support for novel management of honey bees for pollination. Our 'bee'spoke pollination strategy is expected to increase total productivity, reduce operating costs, and enable strategic decision-making for beekeepers while increasing accessibility for pollination services to be provided locally by smaller-scale beekeepers.

This presentation will discuss relevant scientific findings of the programme and highlight specific actions taken to support relevant social priorities such as opportunities for women and minorities and environmental sustainability.



Fighting environmental degradation at grassroots: promoting climate smart agriculture technologies amongst communities in Lake Victoria Basin, Kenya

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Concurrent 2d, Waitākere 1, September 5, 2023, 12:45 PM - 2:45 PM

Impacts of climate change are critical in Kenya. The Nyanza region in Kenya is recurrently exposed to high risks of frequent and severe floods and drought spells, resulting in dwindling agricultural production and food insecurity. This necessitates adaptation to the deplorable conditions.

The objective of this project was to develop an adaptation method which is reliable and affordable for mitigating climate change impacts on environmental resilience through use of climate smart strategies. Specifically, the project investigated the main challenges to environmental conservation in the region; effectiveness of using tree crops and other plant species to increase environmental resilience; efficiency of using farm ponds and large cisterns to provide supplementary water for irrigation during dry spells; and to build capacity of local women smallholder farmers on climate smart strategies for adaptation.

Socio-economic status of the communities was determined through baseline surveys. To determine efficiency of water hyacinth compost on food security and economic incomes of smallholder farmers, on-farm field experiments were conducted. The use of mini ponds for vegetable production was promoted through extension activities.

The results of this project included: increased food production hence food security; improved resilience of farming systems and livelihood strategies of smallholder farmers coping with current climate variability, built in capacity of small-holder farmers on food production, and environmental protection to ensure improved livelihoods. These technologies have increased both land and labor productivity, they are simple, economically viable and socially acceptable innovations and thus widely adopted. The technologies can be replicated, and would increase production in a sustainable way in Kenya to promote improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. The project has high potential for upscaling to wider regions in Kenya, to contribute to climate resilience in the country.



Food spoilage spore forming bacteria in New Zealand dairy farm environment- A North Island perspective

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Concurrent 2d, Waitākere 1, September 5, 2023, 12:45 PM - 2:45 PM

Controlling bacterial contamination especially spore forming bacteria such as Clostridia and Bacillus in the food chain is a big challenge. Spores of these bacteria are ubiquitous and both the vegetative and the heat resistant spore forms can contaminate raw milk via sources along the whole dairy food chain e.g., water, soil, faeces, milking equipment etc, Milk with high spore counts can cause spoilage of raw milk and related products, making it unsuitable for consumption.

Since majority of the New Zealand's economy is based on production of milk and dairy products, too high of a spore count can result in a reduced milk price for the producer as well as rejection of dairy products in national and international markets due to spoilage. Due to the isolation of NZ from its overseas markets, NZ sourced Clostridium and Bacillus could differ to those described internationally. Therefore, it's imperative to investigate the main sources of contamination into our food.

It has been previously reported that farm environment can be an important source of these bacteria that can contaminate the food chain. Therefore, our study aimed at surveying and characterising spore forming bacteria derived from farm dairy effluent from Waikato and Manawatu regions. We investigated and identified the types of spore formers present in these samples using Shahidi-Ferguson Perfringens (SFP) with egg yolk agar media supplemented with polymyxin B (3mg/lit) and kanamycin (12mg/lit) and 16S rDNA PCR. We also developed an advanced tool based on phenotype microarray system to detect these spore forming bacteria from different matrices.

Our preliminary data showed a variety of Bacillus and Clostridium species present in the matrix tested. However, broader analysis of more on-farm and dairy processing samples are being carried out to better understand the food spoilage risk and potential sources of contamination.



Is less more in the transition to a cleaner energy future?

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Concurrent 2e, Waitākere 2, September 5, 2023, 12:45 PM - 2:45 PM

In the emissions reduction plan, the New Zealand government has set out its long-term vision for the energy sector: a highly renewable, sustainable, and efficient energy system. Aotearoa has natural assets that allow for the renewable share of its electricity generation to be consistently over 80%. However, to achieve a 100% renewable energy system new clean energy technologies cannot be the only solution. Consumer behaviour must change to improve energy utilisation.

New Zealand is thought of as a small country, despite having a land area greater than the United Kingdom. The system of government is a representative democracy, which means that every New Zealander has a say in how things are done. This is engrained in the kiwi culture, with citizens affecting big changes that start from small local communities.

Ōtautahi Christchurch is the second largest city in the country, but it still manages to retain small-town resilience and ingenuity. The Christchurch City Council owns and operates its own electricity distribution and fibre optics networks. As such, the city has actively made environmentally conscious decisions in line with the UN's sustainable development goal #7.

To provide affordable and clean energy, initiatives implemented by the city include the development of grid-scale solar, free fibre-based Wi-Fi in the city centre, and deployment of solar panels for key asset energy use. To better utilise the energy produced, the city has also introduced an LED street lighting upgrade, vehicle fleet electrification, and electrifying business utilities.

As the Ōtautahi power landscape continues to progress and new technologies are implemented, learnings from our hapori (community) could spark further changes to the wider industry. As power engineers working for a major regional electricity distribution consultancy, our work directly affects our community, and this presentation demonstrates the work being done and its importance.



Retrofitting New Zealand's existing housing stock to support the transition to 100% renewable energy

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Concurrent 2e, Waitākere 2, September 5, 2023, 12:45 PM - 2:45 PM

New Zealand's transition to clean energy requires energy demand reduction, particularly during seasonal and daily peaks. Energy efficient housing is essential to support this reduction. Research indicates that seasonal peaks in heating demand from New Zealand's existing housing aligns with the national electricity peak demand. Therefore, reducing the heating demand of existing dwellings would address the seasonal supply-demand mismatch and support Aotearoa's transition to 100% renewable electricity. Furthermore, existing housing in New Zealand currently exceeds our allocated operational carbon budget.

Residential retrofit is an effective way to enhance thermal performance, energy efficiency and indoor environment quality of housing, while utilising the existing building stock. Retrofit is essential to reduce heating demand on the grid and reduce the operational carbon footprint of existing housing.

This presentation will present the findings of a Master's research project that examines the energy performance and whole-of-life carbon performance of various retrofit strategies. The aim is to improve the thermal performance of existing detached housing, reducing the energy demand of housing and bringing existing housing closer to Aotearoa's carbon budget.

A range of material retrofit strategies have been developed and tested on a single case study. These strategies are informed by a review of literature, case studies, and existing green building certifications. Quantitative analysis, utilising energy, and carbon modelling techniques are employed to assess the case study's outcomes. The presentation will report on the findings from these analyses.



Grid operations challenges and policy considerations for integrating renewable resources into the U.S. grid

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Concurrent 2e, Waitākere 2, September 5, 2023, 12:45 PM - 2:45 PM

Renewable resources, specifically wind and solar, and the challenges they present to U.S. grid operations need to be viewed within the context of the current grid. An overview of the electricity industry structure and the solar and wind technologies themselves are described to provide a foundation for understanding those challenges.

Electricity in the U.S. is provided by more than 3,000 diverse organizations. The industry's regulatory structure exists at multiple levels including federal regulators, industry organizations, state commissions, and governing boards. The demand for electricity changes constantly, electricity cannot be stored, and electric utility system operators continuously monitor demand to exactly match the portfolio of resources to meet it. Grid operations challenges associated with integrating renewable energy resources include resource intermittency and variability, the availability of renewable resources vis a vis the occurrence of peak demand for electricity, and locations of the resources themselves.

Policy considerations include tax credits, regulatory requirements, energy storage, renewable portfolio standards and net metering. Tax credits have been instrumental in the significant growth of installed wind and solar resources in the U.S. The transmission system was not built to move power from remote resources located multiple states away from the population centers and significant regulatory obstacles arise when such transmission needs to be permitted and built. Energy storage will be required in order to optimize the usage of solar and wind energy resources, particularly as states mandate increased percentages of those resources on utility systems within their jurisdictions. Renewable resources can and will be integrated after consideration and/or mitigation of the real operational constraints that exist in the U.S. electric grid – the biggest machine in the world.



Accelerating national transitions to low-carbon electricity systems and the implications to metals lifecycles: Case of Aotearoa New Zealand

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Concurrent 2e, Waitākere 2, September 5, 2023, 12:45 PM - 2:45 PM

Energy transitions envision the shift from fossil fuels to renewables, and the increase in electrification. Electrification will be driven by the uptake of solar and wind generations. However, solar and wind deployments differ between scenarios, and scenarios have underestimated their deployment over the past decades. In addition, energy models typically focus on direct emissions, thus not incorporating the impacts of supply chains.

The disruptive deployment of wind and solar generation can change the electricity system and shape a low-carbon future. It also can impact the supply chains of metals. The infrastructure required to transform the electricity systems is metal intensive. Thus, the industry needs to adapt to timely deliver the required metals and ensure the supply chains' environmental sustainability.

This study asks: what are the implications of a national low-carbon energy transition for the metals cycles? Aotearoa New Zealand is used as an example. It has set an aspirational target of 100% renewable electricity generation by 2030. A scenario for a disruptive deployment of solar and wind generation is proposed based on the technology diffusion theory. Material flow analysis and a dynamic lifecycle impact assessment are integrated with the electricity scenario.

Wind and solar generation expansion in Aotearoa New Zealand dramatically increases the metals within the electricity system. For example, new wind farms demand much more Zinc, Copper, Aluminium, Chromium, and Nickel. The demand for metals that are harder to process, and classified as rare earth, also steeply increase. Circular economy strategies do not offset the increased need for metal extraction. Enhancing sustainable practices and resource governance throughout the supply chains is required to reduce the environmental impacts during the energy transition.

The lifecycle perspective provides a more holistic understanding of the transition. Finally, the Aotearoa New Zealand experience might guide other national transitions.



A recurrence of vulnerabilities within Decentralized Finance: analyzing notorious DeFi network exploits and deriving implications for the future

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Concurrent 3a, Hunua 1, September 5, 2023, 3:00 PM - 5:00 PM

This paper ultimately intends to reckon with the vast potential of Decentralized Finance (DeFi)—which represents a tangible shift in the future of finance—but also its extensive vulnerabilities. Decentralized Finance is a burgeoning industry in an era of advancing technology, ripe with potential for users and malicious players alike. Stated simply, security is critical for the future of DeFi.

Over the course of this paper, thoughtful analysis is integrated into recurring and varying perspectives of DeFi hacks; common attack vectors that were considered include but are not limited to: private key disclosure, software bugs, smart contract loopholes, liquidity vulnerability, and so on. Supplemented by current-event compositions written by experts in the field, the paper provides a holistic overview of each potential attack vector (such as identifying characteristics and frequency) against the broad backdrop of the DeFi industry. Ten of the most notorious DeFi hacks were then dissected in meticulous detail for their technicalities and scrutinized for mutual points of vulnerability.

Through the aforementioned technical analysis, connections could be drawn between DeFi's lauded commodities and most debilitating points of weakness. The research found that among a small selection of notable hacks, DeFi platforms operating cross-chain bridges or utilizing multi-signature security schemes were most frequently targeted by hackers.

In discussion, the paper elaborates on how these hacks are significant not only for their severity, but for the implications they imply as the DeFi sector continues to evolve. Finally, the paper reiterates remedial actions and mitigation strategies to aid Decentralized Finance platforms in recovery post-attack.



Extreme exploration, Chinese and New Zealand women scientists and engineers venture into the Kermadec Trench, one of the deepest parts of the Earth's oceans

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Ocean depths of between 6000 and 11,000 m are collectively referred to as the hadal zone that are represented by the world's deep-sea trenches. While they only occupy less than 1% of the world's sea floor, they remain one of the least investigated and most enigmatic habitats on our planet. The five deepest hadal trenches on Earth are distributed exclusively along the Ring of Fire of the western Pacific Ocean. Among them, the Kermadec Trench, in the southwest Pacific Ocean, is the fourth-deepest ocean trench in the world with a maximum depth of 10,010 meters.

As part of the Global Trench Exploration and Diving (Global-TREnD) program, an international collaboration funded by the Chinese Academy of Sciences (CAS) and Ministry of Science and Technology (MOST), a research voyage of the R/V Tansuoyihao in late 2022, for the first time, used the full-ocean-depth Human Occupied Vehicle (HOV) Fendouzhe to systematically explore the Kermadec Trench. Four women from IDSSE (China) and NIWA (New Zealand) were among the first scientists and engineers on a scientific expedition to descend to the deepest point and explore the adjacent slopes of the trench.

This presentation provides an introduction to scientific deep-sea exploration in general (and where women have contributed), personal accounts of conducting a (wo)manned dive into a deep-sea trench and highlights the preliminary discoveries of the 2022 Kermadec Trench expedition.



Indigenous car driving simulator

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With the help of man and machine we have developed Indigenous Car Driving Simulator which has actual Alto i10 car model with all accessories. It is used for Evaluating Driving Skills and Psychometric Tests together on a one platform.

It has Full size projector screen to create actual graphics with three projectors to develop three directional images and Open Cabin. It displays through three projectors with $100 < \text{FOV}$ and high Fidelity Sub assemblies. It has complete Force feedback steering, ABC Controls and Gear System.

It covers the all actual live size hazards and traffic scenarios as per Indian conditions. Software Configuration Key Features includes Progressive Training Modules, Psychometric Test, Assessment Modules, Configurable driving conditions under different environmental & road conditions e.g. Rain/Fog; City/Hill/Highway/Rural Roads. It has complete learning and testing module. Different Test to screen driver's behavioural traits have been incorporated including RTO tests.

Finally it gives Full Diagnostic report which includes Psychometric test report for each test and driving skill test report of thirteen parameters.



Real-time invasive marine species detection using computer vision deployed on remotely operated vehicles

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Eradication of invasive species is important for reducing biodiversity loss in many ecosystems. In marine environments, early detection of invasive species is linked to improved success in their eradication. Here, detection is traditionally achieved by human divers performing marine bio-security surveys. This is expensive and can be dangerous. Remote Operated Vehicles (ROVs) offer another tool that can be used to supplement the work performed by human divers. Camera equipped ROVs are increasingly accessible at reduced price-points and with improved usability. But ROV-based surveys typically remain more expensive than those performed by human divers. This is in part due to the time and expertise required to review the captured video imagery. Deep learning is a machine learning (ML) technique that is well suited to image-based object detection.

We present an ROV-integrated system for automated marine species detection with location tracking. The system is designed to be as generic as possible, such that it can be deployed on different ROVs. It is composed of a Jetson Xavier NX board, which is widely used in industry, connected to a GPS unit and an ROV camera. A Python application on the Jetson manages streaming the camera-feed into a ML model for real-time species detection. The NVIDIA DeepStream libraries are leveraged to facilitate integration with a wide range of cameras. The system interfaces with a laptop-based client application, which supports remote system control. The client application also allows configuration to different ROV cameras and supports model updates. We use transfer learning applied to pre-trained convolution neural networks as the basis of our model development process. We then share preliminary results exploring the efficacy of the system when used for Mediterranean fanworm detection. Efficacy is considered by comparing the system detections against those made by two experts reviewing the captured ROV video feed.



Using Unity 3D and interactive 3D visualizations to enhance the accuracy and usability of orchard simulations

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The goal of the orchard simulation's 3D visualization is to provide a realistic and immersive representation of the environment's conditions, such as its dynamic characteristics, environment, terrain, and other features. Incorporating real-world data into a gaming engine is always a challenging task. This is due to the fact that the vast majority of game engines provide extremely limited support for geographical data. Particularly, landscape visualization requires a high number of virtual objects, making the object modeling process laborious.

Unity 3D, a game engine that is frequently used for mobile games development has the capable of displaying geographical data without restriction. By utilizing Unity 3D, we are able to model and properly visualize an orchard and its conditions, compensating for the weakness of integrating environmental, particularly geographic data. This enables users to visualize, explore, and interact with the virtual orchard and its environs.

Our model is particularly useful for studying and analyzing the performance of different food production systems that are adaptable enough to rapidly changing environments. The 3D interactive visualizations allow users to interact with Digital Horticulture Systems simulations at multiple granularity levels, and to pose hypothetical inquiries about the operation of a food production system. It also serves as the platform for visual sensor data for the connected physical orchard or farm.

Overall, this approach can help to improve the accuracy and usefulness of the orchard simulation and to support the development of adaptable food production systems.



Inclusive education of women and girls in STEM sectors for local sustainable development in Africa

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Concurrent 3b, Waitākere 2, September 5, 2023, 3:00 PM - 5:00 PM

Carrying out actions in the field has become essential if we want to ensure STEM diversity and quality. AFISC, in its upstream and downstream mentoring activities, and in collaboration with all stakeholders, gets closer to the needy populations. Innovation's goods and services must be adapted to the socio-cultural contexts of the beneficiaries. Everyone must participate in the construction of sustainable and equitable development. No one must be left behind. Attracting, developing and retaining women engineers and Scientists in Africa to excel in their careers and have a positive impact on building a better future is AFISC's main mission.

The AFISC approach

A vision: To reduce the gaps, the differences, the fractures, to tend towards 0 these inequalities.

$(N-S) + (H-F) + (Fu-Fr) = 0$

N: Three main missions

EXPAND HORIZONS

- Taking the situation locally: It would be preferable for the need to come from the consumer if we want to avoid unnecessary products and save the earth with pollution;
- Making the state of the art locally, nationally, regionally and internationally and adapt practices according to the specificities of each beneficiary.

OVERCOMING OBSTACLES

- Promote active solidarité. Unity is strength.
- Changing mentality: an approach based on complementarity and not rivalry

USE OF INNOVATIONS FOR SUSTAINABLE AND EQUITABLE DEVELOPMENT

- Promote the use of innovations wisely. "Science without conscience is only Ruin of the soul," said Rabelais.
- Green technologies, clean energies, green growth, all these concepts of social and environmental responsibility must appeal to both men and women, young boys and girls in the STEM fields. Woman is the mother of humanity; we can never say it enough!!!



Contextual science learning and student motivation: the case of grade 11 girls in a secondary school in Kenya

Selline Ooko, Dr Festus Kelonye, Prof Samson Nashon,
Prof David Anderson, Dr Elizabeth Namazzi

Concurrent 3b, Waitākere 2, September 5, 2023, 3:00 PM - 5:00 PM

This paper analyses how exposure to contextual science learning at a local informal manufacturing and repairing of ubiquitous household and small farm equipment and machines influenced form three (grade II) girls' motivation to learning and doing science for future careers. Student motivation is essential for meaningful learning.

Meaningful learning of science is the hallmark of a producing workforce within the STEM (Science, Technology, Engineering and Mathematics) field. A review of literature on girls' performance in sciences in Kenya show poor performance at the Kenya Certificate of Secondary Education (KCSE) examinations, a final national examination taken countrywide at the end of secondary school cycle. Despite efforts to focus more on conceptual and empirical content as a way to keep many girls in science, cases of those exhibiting lack of willingness to participate in STEM are still rampant. Hence, the need for the study reported in this paper.

The study employed an investigative case study approach where Form three students from a mixed day secondary school, experienced contextual science learning that involved a full day interaction with artisans at a local Jua Kali workshop. The students moved freely in the workshop asking questions and discussing with artisans questions related to production activities and products. The girls, who often are minority in the STEM field and often drop out science classes at this stage in education were able to participate in discussion even with teachers for the first time. They freely discussed any activities or production related to cooking eg cooking ovens/charcoal stoves. Thus, for the first time the girls in the Mixed day school improved performance in KCSE.

The outcomes of this study point to the need to change and employ teaching strategies that involve students' local environment and cultural practices as these do enhance motivation and positive attitude towards STEM subjects.



Diversity and STEM Equality

Enseignante Associée Rufina Dabo Sarr

Concurrent 3b, Waitākere 2, September 5, 2023, 3:00 PM - 5:00 PM

RUFINA DABO SARR
INWES ARN - DAKAR

Today, omnipresent in our lives, STEM (science, technology, engineering and mathematics) is a key factor for economic and social development. Despite their crucial importance in the process of sustainable development, the well-being of populations and the survival of biodiversity, there are glaring imbalances.

1. Imbalance between developed and developing countries in terms of education, basic and/or applied research;
2. Imbalance between the different sectors;
3. Imbalance between girls/women and boys/men.

The goal of INWES, established in 1964, is to build a better future for the world through the full and effective participation of women and girls in all aspects of STEM.

To achieve this lofty goal, we must necessarily try to address these disparities to ensure diversity and equality in STEM to shape the future.

This paper will address the issue according to the outline below:

Introduction

I. Status of girls and women in STEM fields and careers

II. Diversity and equality in STEM

III. Sustainable Solutions

IV. Recommendations

Conclusion



Why is HE and engineer but SHE isn't? Addressing the female engineering identity in STEM.

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Concurrent 3b, Waitākere 2, September 5, 2023, 3:00 PM - 5:00 PM

From a young age, gender norms create societal roles and expectations of how men and women should behave. Women are constantly targeted by advertising that profits from a lack of self-confidence. This sets a standard of the work performed by each gender and what each excels at. These societal norms extend to the workplace and can force women that enter STEM industries into stereotypical tasks such as administration and support. This further undermines the technical ability of women, perpetuating the narrative that because women are “good” at non-technical tasks, they must be bad technically.

As young women, we see ourselves represented across a range of industries. However, a glaring gap in female representation exists in STEM industries. Due to this an identity as a female engineer is not assumed and must be created by each individual. The pathways into STEM don't currently exist for women as they do for men. When a boy is good at maths, he is told he will be good in STEM, he belongs. When a girl is good at maths the pathways suggested by teachers, family and media are to go into teaching, nursing and other industries that are already female-dominated. Any industry where there is a dominant gender is made worse by this lack of diversity.

As two female power engineers at the beginning of our technical careers, we are only just developing an engineering identity. Within our careers we are championing diversity, challenging the ideals of an outdated system, and changing how we think of ourselves as female engineers. The idea of a female engineering identity and how this can be cultivated in industry will be discussed in this presentation, along with our experiences in STEM and how this shaped our current roles and initiatives.



Encouraging diversity in engineering through sustainability

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Concurrent 3b, Waitākere 2, September 5, 2023, 3:00 PM - 5:00 PM

The University of Auckland's Women in Engineering strives towards ensuring a more equitable engineering force; one of the mechanisms we use to achieve this, is the Women in Engineering "Holiday Camp." This camp is for Year 11 high school students, an integral age group, as this is the year they would select prerequisite subjects to engineering.

"Holiday Camp" works towards attracting female students into engineering through the lens of sustainability and humanitarian impact rather than through physics and calculus- subjects often found intimidating by female students. Our most recent holiday camp was centred around sustainability, featuring activities that directly relate to how engineers can shape our future sustainably. Physics and calculus underpin the ideas explored, but all ideas are presented a sustainability perspective.

Activities included: an ambulance activity where students optimise the vehicle's route to save as many people as possible, an "electric kart" activity where students create an electric car using recycled materials and motors, and a sustainable fuel activity where students move a small car via a hydrogen fuel cell, and more.

Holiday Camp showcased critical stages throughout an engineering journey- current students and industry professionals. Current students volunteered at the camp to work with groups throughout activities and answer any questions. Industry professionals spoke following activities relevant to their work to expose students to the field. This helps to showcase the engineering-to-industry pipeline and increase the visibility of women in industry, a key aspect as fewer women make it to industry than those who graduate the degree.

It's integral that our engineering force is equitable and that those who shape our future reflect its diversity. Holiday Camp works to achieve this by targeting prospective females through accessible topics, like sustainability, and connecting them to the engineering profession and the potential of engineers to shape our future.



Controlling unconscious bias

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Concurrent 3b, Waitākere 2, September 5, 2023, 3:00 PM - 5:00 PM

We started to hold the workspaces at INWES 15 on the theme of "Work-Life Balance".

This is the fifth time for us to share the situation of each country regarding the diversity of working styles, and to explain new ways for women in science to flourish.

We hypothesize that Controlling unconscious bias creates harmony and achieves work-life balance. For this reason, we would like to explore the ideal work-life balance of our future by introducing "obstacles caused by unconscious bias and examples of Controlling them" by introducing the Practices in each country. For example, in Japan, it is unconsciously perceived that housework is done by women. As a result, the difference between men and women in the amount of time spent on housework or childcare is shown in statistical figures.

In Japan, suicide is the leading cause of death among pregnant and childbirth women. This is also thought to have a lot to do with the belief that you have to work hard at both childcare and work. We are interested in training to free ourselves from unconscious assumptions in order to improve these sad situations.

Through training, IJIMA discovered unconscious prejudices and worked to improve them. One example is the change in the percentage of male employees taking childcare leave in Japanese companies.

First, let's look at the disabilities caused by unconscious bias in the work of STEM women. For example, the time spent on household chores, the percentage of causes of death, etc. Next, I will introduce the process of recognizing this unconscious bias. Finally, I would like to introduce a case study. By doing These procedures in multiple countries, we can think about unconscious bias from a broader perspective.



Who's doing Surveying and Spatial Science Honours Degrees and what do they get from it?

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¹Te Whare Wānanga o Ōtākou / University Of Otago, Ōtepoti / Dunedin, Aotearoa New Zealand

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Te Kura Kairūri | the School of Surveying, at Te Whare Wānanga o Ōtākou | the University of Otago in Aotearoa New Zealand aspires to support an undergraduate research programme and culture that promote inclusion, encourage project variety, and inspire future participation. To understand our current position, we have compiled demographic and research topic data, and surveyed students who completed a Bachelor of Surveying (Honours) (BSurv(Hons)), between 2000 and 2022.

Within New Zealand, both the Surveying profession and degree course are male-dominated. Yet within the BSurv(Hons), we find that female students are over-represented relative to their numbers in our programme, while male students are under-represented. Alongside this, female graduates are less likely to report a relationship between honours and career attributes while males are more likely to report such a relationship. Engineering surveying topics featured often in our catalogue of thesis topics, relative to their representation in the Surveying curriculum, and we associate this with forward-looking aspirations in a field characterised by rapid technological innovation. Together, the survey data suggest that career considerations are a stronger driver for male students than for female students who choose undergraduate research.

All of our survey respondents had generally positive recollections of their experience, encouraging others to take it on. In this new work, we expand our demographic analysis to consider the ethnicity and diversity of our cohort and their projects. Examining how students choose honours, we find that lecturers play a large role in the initial stages of the decision, but that personal goals, including 'rising to the challenge', are more often the reason a student ultimately commits. This project allows us to learn from the past and provides insights that will help us develop a thriving and inclusive undergraduate student honours experience at Te Kura Kairūri | the School of Surveying.



An assessment of the impact of the STEM Kenya mentorship program on career choices and employment of young women in Kenya

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Concurrent 3b, Waitākere 2, September 5, 2023, 3:00 PM - 5:00 PM

STEM is a key driver for economic growth. However, gender disparities persist in STEM uptake and school to work transition. Interventions to bridge the gender gaps have increased girls and women's enrollment in STEM globally. In particular, mentorship has proven to be a powerful driver for career development. However, the "leaking pipe" persists as women vanish from careers in science at higher levels. Furthermore, there is limited empirical evidence on the effectiveness of these programs in enhancing women's economic empowerment.

We conducted an evaluative case study to assess the impact of the STEM Kenya mentorship program on career choice, employment, career progression and income levels of young women. This program was launched by UNESCO in partnership with the Government of Kenya in 2014. It was designed to inspire girls to embrace STEM through Scientific Camps of Excellence. We used desk reviews, focused group discussions and in-depth interviews, to gather quantitative and qualitative data.

The respondents were the beneficiaries, the heads and career coordinators of their former schools, government officials at the local and national levels and current employers of the girls where applicable. We reached the girls through a tracer study approach. Provision of critical information on career choices and exposure to role models were the major factors that had influenced career choices, hard work and confidence to compete for male-dominated careers. The highest level of education attained, post-secondary course taken and grades achieved were the main determinants of the income level.

The study therefore recommends lifelong STEM mentorship which should begin at primary school and continue to tertiary levels. This should be coupled with alumni databases to track respondents, monitor impact and strengthen peer mentorship. A National policy on STEM mentorship is suggested to enhance the implementation of similar programs in a more structured manner for sustainability.



Generating flood maps for all Aotearoa

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Concurrent 3c, Waitākere 3, September 5, 2023, 3:00 PM - 5:00 PM

Flooding is one of the costliest natural hazards in Aotearoa. With climate change, the increase in temperature associated with a higher sea level will increase the frequency and severity of floods.

The Endeavour project “Mā te haumarū ō nga puna wai ō Rākaihautū ka ora mo ake tonu: Increasing flood resilience across Aotearoa” is designed to produce a consistent and automated method to generate flood maps. These maps are then used to evaluate the flood risk to the built environment, the societal vulnerability to these events, and to identify solutions to reduce and adapt to flood risk.

The flood modelling workflow has been created to automatically generate flood maps. This automation allows for an ongoing improvement of the methodology and the output with the improvement of data quality, methods and computational power. The methodology was chosen also to rely on open-source codes to allow wider access and transparency. This cascade of tools is initiated by the cut of the national domain into smaller computational entities. A design storm is then generated for the computational domain. The steepest part of the domain is then modelled using the hydrological model TopNet, whose uncalibrated results have been improved by the development of a new groundwater model. Hydro-conditioned DEMs (Digital Elevation Models) are then generated for the floodplain area, using LiDAR data, ocean contours, infrastructure data and a river reconstruction model.

Using these DEMs and TopNet calculated river discharges, the inundation in the flood plain is computed by the hydrodynamic code BG_Flood, a shallow water solver running on a multi-resolution mesh. The cascade of models, implemented as a Cylc suit, has been validated on observed flood events in Westport and Waikanae.



Responsible and ethical use of genomics in forensics

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Concurrent 3c, Waitākere 3, September 5, 2023, 3:00 PM - 5:00 PM

The use of DNA analysis for identifying persons of interest in forensic work, both in criminal investigations and for unidentified human remains, is well established yet evolving. The greater accessibility and affordability of whole genome sequencing enables more information to be gathered about a person from a DNA sample, and the increased use of direct-to-consumer genetic genealogy databases allows further opportunities for identifying people through DNA. However, these evolving uses of DNA analysis in forensic work come with increasing ethical, privacy and sociocultural concerns, and as always, the legislation to provide guidelines for this work is lagging.

Law enforcement and forensic services must develop their own guidelines, which provide for the responsible use of such techniques over and above what is legal or ethical in terms of established guidelines. Issues of individual versus collective (family) consent, indigenous data sovereignty, and tolerance for associative harm should be addressed for a truly responsible approach to implementing new genomic technologies in the forensic field.

This presentation will discuss a responsible approach to implementing Investigative or Forensic Genetic Genealogy, from a year-long social science project.



A national flood awareness system for ungauged catchments in complex topography for Aotearoa New Zealand: development, communication, and evaluation.

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Concurrent 3c, Waitākere 3, September 5, 2023, 3:00 PM - 5:00 PM

Effectively forecasting and communicating flood hazards at national or continental scales is critical to reducing the impacts of flooding. Floods cause over \$40 Billion of damage worldwide every year. In Aotearoa New Zealand, it is the most frequent natural disaster, with an average annual cost of NZ\$100 million for residential properties. The development of national-scale probabilistic river flow forecasting systems remains a challenge due to the predominance of ungauged catchments in often complex and steep terrain.

We will present the model development, communication, and evaluation of New Zealand's first national flood awareness system prototype, the Aotearoa Flood Awareness System, AFAS. River forecasts are produced with an uncalibrated, semi-distributed hydrological model, driven by a high-resolution convective-scale atmospheric model with statistical perturbations in rainfall, soil moisture and baseflow to generate a 50-member ensemble.

We implemented a relative flow and flood exceedance threshold framework to evaluate hourly forecasts across six categories from below normal to extremely high. We assessed forecast performance categorically against observations, for a 2.5-year reforecast period, at 272 flow sites nationwide, up to 48 hours ahead. Overall, AFAS produces skillful streamflow forecasts in catchments with complex topography, even with operational delays ingesting observations. We also explored a novel approach to river forecast communication using daily videos.

We will discuss our experience of providing real-time AFAS forecast information during flood responses on the West Coast in 2021 and 2022. We will present feedback gathered from stakeholder workshops and semi-structured interviews as well as providing real-time information. AFAS appears to be the first river forecasting system to produce public-friendly videos to communicate streamflow forecasts in their topographical context.

Further development of AFAS would benefit from a federated approach across national and regional agencies, including sharing real-time weather observations, forecasting tools and expertise.



Trust Me!! I have the Proof: How a provenance based approach can provide more transparency to IoT Healthcare

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Concurrent 3c, Waitākere 3, September 5, 2023, 3:00 PM - 5:00 PM

A successful application of an Internet of Things (IoT) based healthcare design depends on the accurate and successful delivery of data collected from numerous sources. A significant concern in this system lies while a doctor or practitioner is unsure of the trustworthiness of the data he is working with. He is receiving the data from a multi-layer IoT architecture and therefore, cyber attack at any point of data propagation can manipulate the sensitive patient data. Moreover, as soon as attacks can have serious consequences to human life or create significant damages, it becomes a major concern that doctors are not able to perceive any potential risks or attacks and they are not able to estimate or interpret if the data they see is trustworthy.

To mitigate this problem, we started investigating IoT-Health case studies. We proposed a novel security-aware IoT provenance model, named Prov-IoT that includes security evidence (security metadata) for system security awareness, provide better transparency and risk estimation. These security metadata can be active security controls in the system, security protocols used, version of software used within the system, standards or policies for certain applications, etc. We proposed a protocol for step-wise validation of the security metadata to interpret data trust at any phase of IoT data propagation.

We illustrate that with a list of security metadata, an end-user can estimate risks while he is using the data for decision-making. We evaluate our proposed approach with proof-of-concept implementation. Finally, in this world of growing cyber attacks, our approach would be helpful for doctors to decide whether they can trust the data they see and respond accordingly.



Antimicrobial compounds from root, stem bark

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Concurrent 3d, Waitākere 1, September 5, 2023, 3:00 PM - 5:00 PM

Three compounds, toosendanin, kulactone (2) and scopoletin (3), were isolated from either the root bark and/or the stem bark of *Melia volkensii*. Their structures were determined on the basis of spectroscopic data generated and by comparison with data from the literature. 1 and 2, isolated for the first time from *M. volkensii*, exhibited significant ($p < 0.05$) activity against *Escherichia coli* with minimum inhibitory concentration of 12.5 $\mu\text{g}/\text{mL}$, close to that of neomycin (6.25 $\mu\text{g}/\text{mL}$). The compounds also exhibited high activity against *Aspergillus niger* (MIC 6.25 $\mu\text{g}/\text{mL}$ compared to 2.5 $\mu\text{g}/\text{mL}$ for clotrimazole).

Dichloromethane and methanol seed, hexane stem bark and methanol root bark extracts exhibited activities towards *Escherichia coli*, *Staphylococcus aureus*, *Aspergillus niger* and *Plasmodium falciparum*, respectively. Antimicrobial activity of the plant towards *A. niger*, *P. falciparum* and *S. aureus* is reported for the first time in the work.



The role and source of respiratory sinus arrhythmia: exploration using mathematical models of heart rate regulation and blood circulation

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Respiratory Sinus Arrhythmia (RSA) is a healthy variation of Heart Rate (HR) where HR increases during inhalation and decreases during exhalation. It is present from birth, gets stronger in young and fit adults and exaggerated during deep and slow breathing. RSA decreases with age and its loss is linked with cardiac mortality. But although the presence of RSA is associated with healthy hearts, its physiological benefits and source are still being debated.

To better understand the significance and source of RSA, we coupled a previously published mathematical model of HR control, which includes a model of the lungs and gas exchange, with two different mechanical models of blood circulation. This allowed us to better represent the blood pressure in the HR control model and study the effects of different representations of heart contraction. HR is assumed to be primarily affected by the parasympathetic signal, while the sympathetic signal is taken as a constant in the models. The parasympathetic signal is assumed to be affected by mechanical feedback from the lungs, direct modulation by central respiratory drive, and feedback from the baroreceptors (blood pressure sensors).

We tested two hypotheses regarding the source and function of RSA. Numerical studies using the models demonstrated that the baroreceptors are unable to cause significant RSA in response to changes in pleural pressure (the pressure that drives breathing), and that the main source of RSA is direct central respiratory modulation of the HR. Previously, our model of HR control verified that RSA minimized the work done by the heart while maintaining physiological levels of CO₂. When coupled with models of the circulation, we found similar results when the heart work was calculated as was done previously (using HR) but the minimum occurred at higher levels of RSA when the work was calculated with pressures and volumes.



Understanding the health impacts of vaping: are we there yet?

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Concurrent 3d, Waitākere 1, September 5, 2023, 3:00 PM - 5:00 PM

While smoking rates are declining, vaping and overall nicotine use is on the rise. Electronic cigarettes (ECs) are touted as a safer alternative to conventional cigarettes, but their long-term health effects are unknown. However, evidence is mounting that EC use is not benign. The e-liquids used in ECs and the resulting aerosol contains dangerous chemicals, including carcinogens, heavy metals, and some flavouring chemicals.

We aim to increase the holistic understanding of the impact of vaping on the lungs. To do this, we are using computational modelling to bring disparate aspects of vaping research together. Our work to date has included: 1. measurement of the chemical composition of New Zealand made e-liquids and resulting aerosols, 2. using in silico models to simulate the dispersion of those chemicals within the airways, and 3. application of functional MRI methods to measure regional lung function in healthy vapers' lungs before and after vaping.

We found more than 140 different flavouring chemicals within the e-liquids. In the aerosol, we found heavy metals and degradation products. Simulations show that aerosols travel throughout the airway tree with low deposition rates. Despite this our MRI results demonstrate negative impacts on the cardiovascular system with an increase in pulmonary blood flow post-vaping, which agrees with other studies.

There are two sides to the vaping debate around population health: health protection – governed by concerns over protecting non-smokers from EC use - on one end to harm reduction – with the hope that vaping will reduce the harm to smokers - at the other. Aotearoa New Zealand has opted for a harm reduction approach, only time will tell if this was the right path. We will present our work in this area, including future plans, and present a picture of what we currently know about the health effects of vaping.



Modelling and analyzing the respiratory neural network using Boolean representation

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The respiratory neural network is spectacular in its ability to regulate breathing under a wide range of activities and changing environmental conditions, but its operating mechanisms are not well understood. Mathematical modelling is a vital tool for studying this complex system and models that rely on ordinary differential equations (ODEs) have previously been developed. However, the ODEs-type models have several limitations that we were able to overcome by studying the system using Boolean networks in which the nodes could have only two values: “1” or “0”. Among other things, the new Boolean representation provides a possible explanation of how inspiration and expiration times can be regulated selectively as well as how the neural network can be reconfigured under different control inputs.

Boolean Networks can be converted to discrete linear dynamical systems on finite spaces. This has previously been done by a semi-tensor-product approach. However, the process of getting the linear representation using the semi-tensor-product method is complicated even for a simple three-node network and requires the help of a computer program. We have found a way to skip the semi-tensor process and obtain the same linear representation with a straightforward mapping. Moreover, our approach produces a large number of corresponding representations which provides a flexible framework. Importantly, it could simplify the analytical study of networks with unspecified number of nodes that have some structure.

Our abstract modelling and analysis enable us to predict the behavior of neural networks based on properties of neurons, not their specific parameter values, and easily scale the models to represent breathing rates of different species. These unique abilities of our modelling approach and analysis will help translate knowledge obtained in small animals to humans and develop improved treatments of cardio-respiratory diseases.



Generation Kāinga: Rangatahi building a regenerative and resilient Aotearoa

Keisha Rawiri, Maia Ratana

Concurrent 4a, Hunua 1 + 2, September 6, 2023, 10:30 AM - 12:30 PM

See: Generation Kainga website Science leader: Dr Jenny-Lee Morgan
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Four-year MBIE funded Endeavour project (start October 22)

Project Summary

Generation Kāinga addresses one of the most pressing Māori priorities and greatest aspirations: Māori housing tenure and our ability to exercise authority over our kāinga for the well-being of whānau, hapū, iwi and communities. This research project seeks to unlock the capacity of rangatahi Māori to become key agents in promoting and developing whānau housing and kāinga solutions. Our vision for Generation Kāinga focuses on enabling rangatahi to transform the future of kāinga through Indigenous collective and participatory processes of reimagination, resilience and regeneration so that Aotearoa is 'the best place in the world' for rangatahi and their whānau to live.

The overarching research question that frames this project is:

How do we facilitate and nurture a generation of rangatahi to reimagine and rebuild resilient and regenerative kāinga that will support diverse ways of living as Māori, and transform the future of Aotearoa?

Given the broad focus of this research question and challenge of transformative change in the Māori housing sector, the multiple dimensions that facilitate a Generation (of rangatahi committed to) Kāinga is expressed in, what we have termed, the four ORA (wellbeing) themes: kāinga ora; whenua ora; rangatahi ora; and ōhanga ora. These ORA themes are encompassed and investigated through three key research aims (RAs). The RAs are:

1. To reimagine kāinga as transformational praxis
2. To amplify innovative rangatahi leadership to advance resilient kāinga
3. To engage our collective agency to regenerate kāinga

To meet these research aims and address the complex issues affecting Māori housing requires extensive interdisciplinary partnerships between established and emerging Māori researchers, Māori communities and relevant stakeholders. Generation Kāinga utilises a mixed-methods approach that includes quantitative as well as qualitative methods, to address and better understand the holistic nature of the kaupapa of kāinga development. Kaupapa Māori methods such as wānanga and pūrākau are central to our research approach.

Generation Kāinga will achieve a number of key outcomes, in service of enabling a new generation to engage in hopefulness, equipping them for the huge work of restoring kāinga to be places, spaces and sources of well-being (ora).



Transitioning from PCR and Sanger sequencing to WGS - Legionella typing and beyond

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Concurrent 4a, Hunua 1 + 2, September 6, 2023, 10:30 AM - 12:30 PM

Whole genome sequencing (WGS) is quickly becoming the method of choice for infectious disease typing due to the wealth of genomic data that can be obtained. We have recently established a WGS in-silico PCR procedure for identifying and typing Legionella bacterial cultures by sequencing >100 wild type and type strain isolates.

Legionellae are a notable cause of community acquired pneumonia, and according to the CDC infection often leads to severe disease or even death. New Zealand has one of the highest rates (5.4 per 100,000) of Legionellosis in the world (2.2 per 100,000). Linking clinical infections to an environmental source (source attribution) using sequence based typing (SBT) is important to ensure the cause of an outbreak is identified quickly and remedied to prevent further disease spread.

We found that WGS is a faster and more efficient way of performing SBT for source attribution than Sanger, and using in-silico PCR of the mip gene produced comparable or improved identification for >95% of isolates tested, encompassing more than 30 different Legionella species. All discrepancies were determined to be a limitation of database content rather than flaws in the sequencing methodology. Comparable or improved results were also obtained for 100% of the 30 L. pneumophila isolates that underwent SBT using in-silico PCR.

In future we hope to use WGS to expand the surveillance of Legionella infections in New Zealand to include antimicrobial resistance patterns, an area that is not currently monitored. Further projects aimed at transitioning the established testing regimes of more bacterial species from traditional PCR and Sanger sequencing practices to WGS are currently underway at ESR, and some additional results may also be presented depending on the project timelines.



Addressing sex bias in medicine: A sex-specific digital twin of the cardio-respiratory system

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Concurrent 4a, Hunua 1 + 2, September 6, 2023, 10:30 AM - 12:30 PM

There is growing awareness of the need for precise diagnosis and treatment of disease that is tailored to an individual, in order to optimise patient outcomes. Digital twins offer the potential to inform personalised treatment strategies, which in turn will maximise efficacy and productivity in healthcare delivery. A digital twin is a data-driven digital representation of a physical object or system, that can be used to simulate different scenarios. While having been used successfully in manufacturing, space missions, and other applications, the clinical translation of digital twins is only just developing.

There is substantial historical and prevailing sex bias in medicine. The lack of recognition of sex and gender differences in biology and medicine may lead to imprecise or inappropriate devices, technologies, or medical care for half of the population. This is an issue that research is only beginning to address—it is no longer acceptable for studies to be performed exclusively using male animals, or for women to be excluded from clinical trials. Nevertheless, a large gap persists in sex-specific healthcare. Sex differences in physiological mechanisms have been shown to exist, highlighting the fact that a one-size-fits-all approach to health and disease is not fit for purpose.

This presentation will consider the development of a sex-specific digital twin of the cardio-respiratory system for application in pulmonary hypertension. There are known sex differences in morphometry of the human respiratory system, incidence of pulmonary hypertension, and the effects of cardiovascular disease. We will present our pipeline for creating subject-specific models of the heart and respiratory system, and discuss issues associated with the reproducibility of measurements and model predictions, and how differences between sexes can be factored out of analyses. Finally, we will discuss why incorporating sex and gender differences into medicine is vital for improving health outcomes for all.



Simplified, saliva-based PCR testing for greater public health impact

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Concurrent 4a, Hunua 1 + 2, September 6, 2023, 10:30 AM - 12:30 PM

Background. The COVID-19 pandemic presented an unprecedented demand for diagnostic testing. Testing was essential for isolating infected individuals and epidemiological surveillance for public health countermeasures, but was frequently strained by high costs, inadequate infrastructure and supply chain disruptions. To overcome these challenges, we developed a low-cost, open-source test in an effort to deliver equitable testing. Key to this was saliva.

Methods. We developed 'SalivaDirect' to simplify testing through: demonstrating the sensitivity of saliva for SARS-CoV-2 detection; developing clear self-collection instructions; eliminating collection tubes with preservatives; bypassing nucleic acid extraction; validating each step with reagents and instruments from multiple suppliers; demonstrating stable detection after prolonged periods at elevated temperatures; and establishing a novel regulatory model. Recently, we have validated this approach for the detection of influenza A/B, RSV and mpox.

Results. Since being granted emergency use authorization (August 2020), 200+ laboratories across 42 US states have been designated to deploy the SalivaDirect SARS-CoV-2 protocol; more than 8 million tests have been run. SalivaDirect's open-source, streamlined design allows laboratories to utilize existing infrastructure, thereby facilitating rapid scale up, while enabling quicker turnaround times and ensuring actionable results. Additional approaches, including unsupervised self-collection, direct-to-consumer collection kits, and pooled sample testing, increase autonomy, making it an invaluable option for numerous communities.

Conclusions. The advances in test innovation throughout the pandemic have demonstrated what could be possible for respiratory pathogens across the board. Our extensive validation of saliva and the international implementation of SalivaDirect has demonstrated saliva as sensitive and reliable for SARS-CoV-2 detection. Importantly, this simplified approach is demonstrating applicability to other infectious diseases. Being less invasive and less resource-intensive than other sample types, saliva-based testing can lead to more equitable and sustainable testing and surveillance programs. As a result, saliva can bolster the public health response, particularly in low-resource and remote environments.



Making a difference in the Pacific

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Concurrent 4b, Waitākere 1, September 6, 2023, 10:30 AM - 12:30 PM

Relationships are the core to nurturing positive outcomes in partnership with Pacific communities. With a spirit of collaboration and sharing diversity, inclusion and belonging stories, Karina Kaufusi and Andrea Rickard share journeys of celebrating intertwining of Pacific cultures with Beca's 102 year whakapapa.

Beca's Pasifika Network launched in November 2022. The network is colleagues across Beca with ties to the Pacific. Karina describes this milestone as the start of “a new chapter for the history books of Beca”. Aotearoa is part of the community of Te Moananui a Kiwa, and goals are supporting Pacific communities, making a difference by involvement in meaningful projects with communities. This paper shares our approach of creating an environment that empowers Pasifika people to thrive. A place of support and pride in Pasifika heritage. A place where we can play a small part in increasing the capability and capacity of our Pacific neighbours through partnering with local businesses and supporting communities.

Growing up in a Tongan family, coming to engineering school at Auckland University and then joining Beca, was a new journey for Karina. She remembers starting has a graduate at a time when there were not many people who looked like her. She struggled to connect and find her place in a big organization, though that is slowly changing now. For Andrea, growing up in a pakeha family in Tāmaki Makaurau and working alongside our growing network of Māori and Pacific peoples for over 25 years, she knew she was only starting a journey of learning and discovery. Andrea and Karina share two different stories of their career journeys involved in infrastructure design and delivery, the richness that the diversity of different cultures is increasingly bringing to infrastructure projects and to communities we serve, and about a journey of learning, growing and respect.



Stimulating sustainable entrepreneurial (SSETS) thinking for impactful research and enhanced employability of STEM graduates

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Concurrent 4b, Waitākere 1, September 6, 2023, 10:30 AM - 12:30 PM

University education is considered a critical pathway to guaranteed professional work life. This is because universities play an essential role in creating new knowledge and innovations, and training the next generation of leaders. Entrepreneurship and innovation is key for the development and transformation of the African economy and the provision of graduate employment. However, despite heavy investments in University education more than half of 420 million young young people are unemployed. Hence, Universities must translate into entrepreneurial institutions by offering globally competitive and relevant programs. This is especially critical in STEM which is not only key to technological innovations and job creation but also sustainable development.

The paper will discuss DIFFERENTIATE, a gender responsive, place-based approach to designing and developing entrepreneurial capacity building across African Universities. The overall goal of the project was to foster the culture of innovation and entrepreneurship within universities for impactful research, employability and job creation. This involved situational analysis to establish the entrepreneurial ecosystem in Africa. This was followed by the co-development and piloting of tool kits geared at Stimulating Entrepreneurial thinking (SSETS) among students and Science faculty based on prevailing local contexts.

The study revealed that entrepreneurship education (EE) is not yet fully integrated into the activities of Universities across Africa, with most universities having no entrepreneurship capabilities or curriculum and a few having limited entrepreneurship training and support for students and staff. Integrating EE into the core businesses of many universities is also fraught with difficulties, including capacity to deliver EE, weak University-industry linkages as well as wider challenges such as trust between different stakeholders within local entrepreneurial ecosystems. The need for institutional mindset change from technology driven to challenge-driven research was also hailed as the way towards creating entrepreneurial Universities.

The paper will present the process, outcomes and recommendations of DIFFERENTIATE.



Gender inequity in Australian research grants broadly reflects the workforce

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Concurrent 4b, Waitākere 1, September 6, 2023, 10:30 AM - 12:30 PM

Gender disparities exist in competitive research grant programmes. Our research examines if grant programmes are biased or whether the disparities are representative of the research workforce.

We modelled twenty years (2000-2020) of Australian government awarded grants according to lead investigator gender and compared them to grant application rates and research workforce participation rates. Generally, our modelling shows there are fewer women than men in the research workforce and applying for grants, which translates into women receiving a lower percentage of awarded grants, with the greatest disparity seen at the highest levels of seniority. Specifically, the percentage of funded projects led by women closely matches application rates and is slightly higher than workforce participation rates.

Temporal trends in the percentage of funded projects led by women indicate changes towards gender equity over time. The strongest temporal trend is among professors, for whom the greatest gender disparity in funded projects is observed. Within a scheme and year, successful projects led by women tended to be awarded the same amount of funding per grant as projects led by men.

Our findings point to a complex issue that extends beyond research grants. Action is needed across the research sector to remove the multitude of systemic and cultural barriers that disadvantage women, non-binary, and other underrepresented researchers.



Writing women scientists back into history

Asha Gopinathan¹

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Concurrent 4b, Waitākere 1, September 6, 2023, 10:30 AM - 12:30 PM

In this talk, I will discuss my current work on writing the biography of the Indian physicists Anna Mani, Sunanda Bai and biologist E.K Janaki Ammal.

How does one write the life of a scientist – is it just confined to their scientific work or does it also involve other matters too ? What led them to choosing their scientific discipline, their education, the encouragement or discouragement from family and friends. The ability to find jobs, their progress in their careers and the role played by mentors.

The women I have chosen were all born in pre-Independence India. They were to a large extent shaped by the national movement for freedom around them. This spilled over into the work arena too. They wanted and strived hard to contribute to the new nation's development whether it be in the area of meteorological instrumentation, solar and wind energy as in the case of Anna Mani or cytogenetics, phytogeography, taxonomy, ethnobotany and reorganising the Botanical Survey of India as in the case of Janaki Ammal.

Locating primary sources can often prove to be difficult as there are virtually no archives where the personal and professional documents are neatly filed. Often the most unlikely of persons or places leads to materials in the form of photographs, letters. Some individuals who have worked with them also have contributed significantly by their narration of events. With persistence and luck, things do fall into place and a story evolves.

For women in India, other Third World countries or women of colour in other parts of the world, there is a real lacuna in role models from their own background in STEM. One hopes that this work will begin to fill in that gap.



Digital Innovation: Integrating Planetary Boundaries into Decision-Making

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Concurrent 4d, Waitākere 3, September 6, 2023, 10:30 AM - 12:30 PM

Planetary boundaries define the safe operating space within which humanity can thrive while respecting the Earth's ecological limits. Historically, the design of our business models and built environments largely ignored these boundaries, using high carbon materials, optimizing for efficiency, cost and profit while leaving society or other market forces to deal with the aftermath. This approach is now being challenged and new imperatives are being driven through a range of sustainability and just transition mechanisms. While this progress is great to see, we still need to provide designers and decision makers with the tools necessary to incorporate planetary boundaries into the decisions of the future.

We need to take designs of tomorrow: roads, bridges, and buildings and apply artificial intelligence, life cycle impact analysis and environmental pricing to calculate the hidden cost of externalities such as greenhouse gases, land use conversion, water consumption, air pollution and ecotoxicity.

Digital tools like AI and 3D modelling can assist in this process by collecting and analysing vast amounts of data from various sources to provide decision-makers with real-time insights into planetary impacts and identify potential risks and opportunities. These tools can be utilized to compare different products and services, identify potential environmental risks and suggest more sustainable alternatives, guiding companies and policymakers in making more environmentally responsible decisions.

Leveraging the combined power of engineering, AI and environmental impact analysis allows decision-makers to rapidly perform a life cycle analysis for specific products or materials that can feed back into an iterative design to decrease impacts. For example, organisations can calculate the true social cost of a future road. We can understand if various wearing courses are better or worse – ultimately being able to quantitatively balance trade-offs between performance, local content, cost and sustainability.

Integrating planetary boundaries into decision making is a crucial step toward ensuring the long-term well-being of humanity and the planet.



Engineering innovation and the circular economy

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Concurrent 4d, Waitākere 3, September 6, 2023, 10:30 AM - 12:30 PM

Engineering has traditionally been resource extractive and pollutive with its take-make-use-dispose or “linear economy” approach to technology. This has destabilized our earth processes and caused humanity to operate beyond our planetary boundaries.

The Circular Economy takes a systems approach to decouple economic activity from the consumption of finite resources. It is based on three principles from the Ellen MacArthur Foundation: design out waste and pollution; keep products and materials in use and regenerate natural systems. There are 5 Business Models namely: Circular Supply, Resource Recovery, Product Life Extension, Product Service and Sharing Platform.

Key to the achievement of the circular economy is sustainability which are embodied in the United Nations 2030 Sustainable Development Goals (SDG). Particular to engineering are SDG 9 on Industry, Innovation and Infrastructure and SDG 12 on Responsible Consumption and Production. Building the circular economy requires innovative solutions that transform industries. Thus many eco-innovation start-ups are powered by Industry 4.0.

The academe has an important role in training students to apply innovation leading to a Circular Economy through a Conceive Design Innovate Operate (CDIO) approach that emphasizes both Systems and Design Thinking. Academic, national and global Start-Ups are essential to support innovation coaching, makerspaces, digital catalysts, incubators leading to business models.

The Circular Economy is an opportunity for Engineering and Innovation. If we are to achieve a more sustainable, circular, resource efficient future, every new technology, material, and system needs to be designed with the principles of circularity in mind. Only then will we be able to minimize our burden on the planet.



A European view on unlocking the Circular Economy

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Concurrent 4d, Waitākere 3, September 6, 2023, 10:30 AM - 12:30 PM

Governments around the world are recognising that the current 'take-make-waste' linear economy based on extraction, exponential growth and overconsumption of natural resources is a significant contributor to climate change, biodiversity loss, depletion of natural resources, ocean acidification, and pollution. This has led to significant momentum to transition to a more Circular Economy (CE). Whilst the CE approach originated from a focus on waste minimisation and resource efficiency, it's now used globally as an overarching framework for unlocking economic development addressing broader social and environmental challenges.

Leading edge thinking from Europe recognises the need for our traditional linear approach to be transitioned to one that can manage a multitude of scales, complexities, and uncertainties to be successful. The future challenges our cities face needs collaborative effort, new tools and technology, different skill sets, and systems thinking to co-create visions and strategies that can be actioned.

The move away from our traditional approaches needs to support new thinking, different questions, creation of space to experiment and enable innovative ways to develop our urban forms.

The co-creation of circular visions, strategies and actions with all actors participating will translate into new positive outcomes on the ground. We need to be brave, collaborate and willing to fail on our journey towards our end goal of circular, sustainable cities and regions. How might we sculpt this new venture together?



Busting myths about women engineers

Miss Daphne Deidre Yong Teng Wong¹, Thea Kurniawan¹, Mrs Bethany Smith¹

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Concurrent 5a, Hunua 1 + 2, September 6, 2023, 1:30 PM - 3:30 PM

When discussing family-friendly or women-friendly careers, engineering is unlikely to be the first that comes to mind. In an effort to make a positive shift, recent decades have shown movements towards achieving gender equality, especially in male-dominated workplaces and within the STEM field. While the representation of women is more prevalent now more so than ever, statistics from Engineers Australia showcase that only less than 13% of qualified engineers are women (2019).

In order to further decipher the reason behind this statistic, the authors conducted a survey to understand the public perception of women in STEM, in particular that of the younger generation - the prospective future engineers. In our survey, less than 15 % of the respondents identify engineering as a family-friendly job, and even less considers it women-friendly. Unsurprisingly, the jobs that are perceived as family and women-friendly are in the likes of teachers and hospitality workers.

Based on the survey results, and follow up conversations with a selected number of survey participants and practicing female engineers, the authors seek to present tangible actions to bust the myths about women engineers. For example, technology and working style advancements have made a significant portion of work able to be conducted in a flexible environment, i.e. working from home. Furthermore, policies supporting flexible working hours have been proven to aid working mothers balance career and personal/family goals.

The growing network of women's support groups within workplaces, together with corporate movements towards achieving gender equality needs to be better communicated to the public, especially regarding male-dominated sectors such as engineering. The public perception of women in STEM may hinder the decision one makes to pursue a career in engineering. Thus, it is important to engage the future generation in honest conversations about women engineers to allow them to make better-informed choices.



Making STEM and maths more gender inclusive: lessons from a new model for engineering education

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Concurrent 5a, Hunua 1 + 2, September 6, 2023, 1:30 PM - 3:30 PM

There are moves in the UK and elsewhere for new ways of training engineers. NMITE, the New Model Institute for Technology & Engineering, is one. NMITE is a new higher education institute in Hereford, England, with inclusion, innovation, creativity at its core. The model is based on collaboration, learning-by-doing, readiness-for-work. The intention is to open engineering to all: the areas around Hereford suffer from low-skilled workforce, and in addition, engineering in the UK suffers from a low proportion of women. The first cohorts of students are not as diverse as the proposers of NMITE hoped. NMITE appears to be achieving targets for socioeconomic inclusion, but not yet meeting hopes for gender diversity. It is not all bad news: the cohorts do have a slightly better representation than is usual for the UK at 25% students who identify as women, plus our female students report feeling included. The academic team at NMITE, however, seeks to reduce all unnecessary barriers and continuously challenge the status quo, both for gender equality and wider diversity.

This presentation outlines ways in which inclusion, particularly gender, is embedded in the student journey through NMITE. We will focus on the role of the Academic Skills and Knowhow (ASK) centre and on the design of a new Foundation Year facilitating entry to NMITE for those without the usual prerequisites. The ASK provides mathematics teaching for core modules. In the UK, maths is one of the gender barriers as our education system introduces accidental biases against girls taking up maths. The approach taken by the ASK and in the Foundation Year is to challenge assumptions about maths, with the aim of reducing barriers to engineering. This will have an impact on gender representation, and ensure we are identifying true engineering talent in all.



From ICWES9 to ICWES19 - Observations from an ICWES time traveller

Prof Suzanne Wilkinson¹

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Concurrent 5a, Hunua 1 + 2, September 6, 2023, 1:30 PM - 3:30 PM

In 1991 I was a PhD student in Civil Engineering at Oxford Brookes University. I attended my first conference as a research student. This was ICWES9 at The University of Warwick. At ICWES9 I learnt from the speakers that I needed to be visible, courageous and to speak up for what I believed to be the right thing to do. At that time women in engineering were in a minority (generally less than 10%) and research from Robinson and McIlwee, in the US, argued that "... the culture of engineering, strongly identified with the male gender role, works against women. Where that culture is strongest, women do most poorly in occupational status and mobility".

Time travel 30+ years, and a recent 2022 report from Engineers Australia said "Most female engineers feel valued at work and are passionate about their work, however there are significant issues for women with workplace culture and unequal opportunities." and goes on to say "... only 55% of female engineers say they have equal opportunities to men, and nearly 1 in 5 say there is bullying or exclusion of women in their workplace".

Equity, inclusion and diversity still appear to have a way to go. Through the lens of my own engineering career, my presentation will travel through time, to recall what themes were being discussed by women in engineering in 1991, compare them to where we are now in 2023, and examine what Universities, in particular, need to do to prepare our female engineers and scientists to face a future in these professions.



The movement driving change for women in engineering and architecture

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Concurrent 5a, Hunua 1 + 2, September 6, 2023, 1:30 PM - 3:30 PM

Powerful things happen when people come together to demand change. Which is why in 2018 Engineering New Zealand, ACE New Zealand, and New Zealand Institute of Architects, came together to create the Diversity Agenda. Born from a hunger and willingness to change the engineering and architecture professions within Aotearoa for the better, for everyone.

Over the last four and a half years we've grown the movement to more than 150 firms committed to diversity, equity, and inclusion. We've led the conversation and held events up and down the country to raise awareness, connect members and provided resources to enable action, and now have an Accord for firms to make the ultimate commitment with an annual summit assuring accountability for that action.

There aren't many movements like this one, where firms have joined forces for change across professions, receiving recognition through national and international awards.

The movement started with the goal of increasing the number of women in engineering and architecture by 20 per cent by 2021. It's since expanded with some big goals such as ensuring all members have a diversity and inclusion strategy in place, close their gender pay equity gaps and develop cultural competence in Te Ao Māori. These goals are set out in a recently released Diversity Agenda strategy – our pathway to 2025 – which focusses on creating pathways for participation and growth, creating equitable and inclusive cultures where everybody thrives and continuing to grow our network of champions advocating for diversity and inclusion.

This paper will speak to the Diversity Agenda's journey – what's worked well, what we've learnt, and provide inspiration for others to follow suit – for those who have been excluded, for those denied the opportunity to thrive, and for those who have not seen our professions as a home for them.



Perceptions of Gender Barriers in Science and Engineering and the GISE Index: Tools for Change

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Concurrent 5a, Hunua 1 + 2, September 6, 2023, 1:30 PM - 3:30 PM

The Association of Korean Woman Scientists & Engineers (KWSE) and INWES have run two international surveys in 2021 and 2022 on perceptions of gender barriers in STEM. These built on KWSE's surveys from 2014-2018 in Korea and then across Asia. This presentation will discuss the contexts and approaches adopted, the implications of confounding variables and sample sizes, the lessons learnt, and findings of these two surveys.

These surveys are part of an ongoing project, Gender barriers In Science and Engineering (GISE), to gather statistical data on gender perceptions in the STEM fields by country, gender, and age. The project aims to play a key role in building a policy road map for the balanced development of future human resources worldwide.

The GISE surveys asked respondents for their views on, and experiences of, gender barriers in STEM education, research and in the work environment. In 2022, the survey reached 79 countries and nearly 3000 respondents, particularly across Africa. It targeted all genders, across career stages from student to just retired, and all STEM specialisms, including medicine, architecture and the social sciences. The objective was to compare perceptions of barriers not only by gender, but also by country or region, career stage, STEM sector, and relevant socioeconomic factors relevant to the country or region.

In addition, the GISE Index, developed as part of this project to act as an indicator of the progress towards gender equity in STEM, will be presented. The construction of the GISE Index and interpretations of the sample results will be outlined. The initial outputs are promising and it is hoped that index will become a tool for change to influence future policy and action recommendations for gender equality in STEM.



Generation and emissions of geothermal powerplants in New Zealand.

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Concurrent 5d, Waitākere 1, September 6, 2023, 1:30 PM - 3:30 PM

Geothermal Energy is considered the cleanest and most sustainable source of energy. However, the geothermal fluid used for electricity generation may bring some gases to the surface mixed into it. The content of these gases in the geothermal fluid varies from site to site due to the geological settings. The geothermal fluid is usually reinjected back into the ground, and the separated gases are released into the atmosphere.

New Zealand generates about 18 per cent of its electricity from the geothermal energy source. The net emissions from the geothermal system are very low compared to other energy sources. However, some of the geothermal power plants in New Zealand emit high greenhouse gases during the electricity generation process. Those power plants have become an issue of significant concern as New Zealand has set two critical goals for the next few years. One is generating 100% electricity using renewables by 2030, and the second is reaching the zero emissions goal by 2050.

As geothermal plays an essential role in generating electricity, a solution must be figured out for handling these greenhouse gases emitted by geothermal power plants. This research is a step towards finding solutions for reducing emissions from the high greenhouse gas-emitting geothermal power plants without impacting the power output from the power plants. The impacts of gases on different parts of the geothermal system are considered, and a suitable method will be developed based on the analysis.

So far, research has been done on the Production and the above-ground systems, and the presence of these gases in the geothermal fluid showed a positive and negative impact on them, respectively. Based on these analyses, the reinjection of greenhouse gases back to the ground could be considered a solution for reducing emissions from the geothermal electricity generation process.



The roadmap to net-zero with geothermal resources in Aotearoa New Zealand

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Concurrent 5d, Waitākere 1, September 6, 2023, 1:30 PM - 3:30 PM

New Zealand Geothermal Association, incorporated in 1992, is a non-political, non-government and not-for-profit organisation, with a focus on fostering a sustainable future for Aotearoa New Zealand through use, development, and protection of geothermal resources.

Geothermal is an abundant energy resource in Aotearoa that the world looks to with envy. We have the second highest installed geothermal energy profile per capita in the world (second only to Iceland) and are part of the elite group of countries who have more than 1000 MWe of installed geothermal electrical capacity.

The challenges from the COVID-19 pandemic, the global economic inflationary environment and the energy crisis amplify the urgency to curb our emissions. We no longer have the luxury of time to allow for a weak response to our Paris Agreement.

Aotearoa New Zealand must step up as a climate leader, strengthen our emissions reduction and place Tiriti o Waitangi (the Treaty of Waitangi) and equity at the heart of our climate response. The tools to achieve internationally significant change are within our borders, we must be brave and embrace them to ensure that we can meet our net-zero targets.

Aotearoa currently has more than 1050 MW and growing with 500 MWe additional geothermal electricity generation ready to be tapped with low-carbon emission profiles.

The presentation outlines the unparalleled challenges experiencing in the New Zealand's energy system and offers a roadmap to net-zero with geothermal resources.

Apart from the increased electricity generation, geothermal resource plays an even greater role in our low carbon energy future.

We invite you to join us in Aotearoa New Zealand's geothermal future.



How do we ensure New Zealand's geothermal use is sustainable?

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Concurrent 5d, Waitākere 1, September 6, 2023, 1:30 PM - 3:30 PM

Geothermal energy has a strong place in the renewable energy mix in New Zealand and has significant untapped potential for both electricity production and direct use. However, historic overuse has resulted in environmental impacts including declining geysers and hot pools. This shows that geothermal resources are not infinitely renewable and understanding them is important when managing use. Numerical modelling of geothermal systems helps in two ways: 1) improving understanding of the fluid circulation occurring subsurface and what is influencing it, and 2) determining thresholds of sustainable extraction and reinjection. We use models of heat and fluid flow to explore these issues.

In the Ōkātina Volcanic Centre in the North Island of New Zealand, geothermal systems occur around the margins of multiple successive collapse calderas. Simplified models based on geophysical datasets show that over half of the systems result from fluid rising from localised heat sources and being pulled to the north by topographic forcing.

In the Tauranga low-temperature geothermal system, to the north of the Ōkātina Volcanic Centre, warm water is extracted for use in bathing, agriculture and horticulture. Sparse, poor-quality data makes meaningful modelling challenging, but suggests that current use of the resource is sustainable. However, consented usage rates are significantly higher than current use and would result in problems for the resource.

New Zealand's geothermal resources are important as a clean, green, weather-independent energy source. Sustainable use requires careful management however, and balancing use and protection is an on-going challenge that requires more data and stronger collaboration across industry, councils and research organisations.



Female school students in the United Arab Emirates: Promoting STEM through university-based science workshops

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The United Arab Emirates is a small country located in the Arabian Gulf, about as far away from New Zealand as could be. Its educational systems have been developing since the discovery of oil in the early 1960s, and in six decades vast strides have been made in female literacy, access to and attendance in education. Currently, females outnumber males in tertiary education. Although enrolment figures for STEM degrees have also been increasing, there are still disparities between STEM graduates; 41% female v 59% males (WEF Report , 2022). Wider discrepancies exist in the STEM workplace.

In this AARE funded project, we trained Emirati science students from the country's main STEM university, to provide hands-on workshops for Emirati school students aged between 14 and 18 years old (male and female, though data about females only is presented here). We wanted to find out if these workshops had the potential to positively impact students' science study and career aspirations through exposure to the university setting and to science lab-work facilitated by people from their own culture and ethnicity. This is unusual, because the vast majority of teachers in UAE schools and universities are non-Emirati expatriates. 130 female students responded to a mixed-methods questionnaire containing 30 items.

We found that the female students had high degrees of interest in science, and mostly non-stereotypical perceptions of who 'performs' science and what scientists do. This bodes very well for the country's future female STEM workforce. We also found that students were more likely to express an interest in studying science at university after participating in the workshop. Significant themes emerged from the qualitative data about the positive impact of seeing Emirati trainers in STEM roles, the majority of whom were women.



From Nigeria to New Zealand: Challenges and opportunities

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The importance of diversity in an organization, or society in general, cannot be overemphasized. It is associated with higher rates of productivity and performance and drives creativity and innovation. So, it is a good thing that diversity in science, technology, engineering, and mathematics (STEM) has shifted over the past decade. Despite these positive changes, differences persist in this sector around the world.

This presentation will examine what the challenges are, why they emerge, and how it impacts the experience using my experience as a case study. The case study will be focused on the challenges and opportunities of moving from the education and cultural background in Nigeria to New Zealand, as a woman in STEM. Sharing my story offers a useful perspective on strategies to address these issues.



Women in Engineering at University of Auckland - where to from here?

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The purpose of the Women in Engineering Project was, and still is, to increase undergraduate enrolment of self-identifying females in BE(Hons) at University of Auckland (UoA). This project began in 2019 with industry sponsorship, and is now embarking on a new phase of STEM engagement.

The main pillars of the project are:

- Promoting diversity and inclusion, and increasing visibility of Women in Engineering,
- Facilitating relationships across the Education sector and with industry, and
- Enhancing the impact and effectiveness of outreach and engagement activities.

The most obvious way to achieve our purpose is to increase the potential pool of self-identifying female applicants coming through high school, by identifying and helping to overcome the barriers that result in them being ineligible for enrolment, choosing not to apply, not being selected for or rejecting an offer from our Faculty. We will share our successes and learnings over the last 4 years, and hear some personal career stories from current engineering students.

We also explain how we have worked with industry partners to increase interest in, and exposure to, Engineering as a desirable career option for school students. This helps to address incorrect perceptions of Engineering, and give school students relatable role models to support their aspirations.

We will outline our long-term strategy for engagement with the Education sector, that highlights gender diversity and encourages more students to continue studying Maths and Physics throughout their schooling.

The project team is constantly looking for ways to engage with the education community, through our outreach visits, expos, hosting events, and running workshops. We are also looking to collaborate with like-minded STEM outreach and education groups, to ensure efficient and effective use of our resources, and expand the reach of STEM across the country.



Impact of fibre orientation on the mechanical performance in moulded fibre packaging.

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Moulded fibre packaging has long been considered low-cost, and low-performance. It is commonly found as egg cartons, take-away food packaging, and protective packaging for electronic items. Until recently, research on moulded fibre production was limited and innovation was low. As the need for sustainable packaging is on the rise, interest in this technology is rapidly increasing. A recent well-known innovation is the moulded fibre bottle released by Carlsberg in 2017.

One of the reasons for the poor performance of moulded fibre products is the lack of orientation of fibre within the product. During the standard moulding process, fibres are randomly distributed, resulting in a moulded fibre object with non-orientated fibres. Fibre alignment can increase the mechanical performance of the product, however aligning fibres using current production methods is challenging.

For this study, both bench-top moulded fibre forming equipment and a pilot scale moulded fibre thermoformer were used. With the benchtop equipment, it is easier to manipulate the fibre orientation in the moulded fibre process and change parameters than with industrial scale equipment. The pilot-scale thermoformer however, reflects the boundary of what is feasible on a commercial scale.

In the study, multiple moulded fibre objects were produced with a range of different fibre orientations. This was enabled by influencing fibre flow patterns in the headbox during forming. The properties of the resulting object with varying fibre orientations were determined showing a difference of up to 30% in cross-direction properties.

In conclusion, numerous opportunities to improve the performance of moulded fibre packaging are imaginable. Creating moulded fibre packaging with similar mechanical properties to single-use plastics means these products can be substituted to replace the use of this non-recyclable packaging which is in the process of being banned globally.



Effect of various printing parameters on the accuracy (trueness and precision) of 3D-printed partial denture framework.

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Removable partial dentures (RPDs) are a popular and affordable alternative to implants or fixed prosthodontics. Recent increases in elderly populations have led to a growing demand for RPDs worldwide. The aim of this study was to measure and compare the accuracy of 3D-printed materials used for RPD production to improve workflow and eliminate errors in manufacturing.

A partially edentulous maxilla (Kennedy Class III, modification 1) was prepared with guiding planes, rest seats and clasps. A total of 540 3D-printed RPDs were 3D-printed with the following resins: DentaCAST(Asiga), SuperCAST(Asiga) and NextDent(3D-Systems). To evaluate the trueness of the printing materials, three types of layer thickness were used: 50 μ m, 75 μ m and 100 μ m, two types of build angles: 0° and 45° and three types of plate locations: side, middle, and corner. All specimens were scanned and superimposed with a digital control sample. Best fit alignment method was used, and root mean square error (RMSE) calculated discrepancies of print accuracies as a whole. To capture region specific discrepancy, 10 points of XYZ internal discrepancy within RPDs were measured and Euclidean error was calculated.

Optimal results were found using 45°, middle of the build plate and layer thicknesses of 100 μ m(DentaCAST), 75 μ m(NextDent), 50 μ m(SuperCAST), which were clinically acceptable. Layer thickness was a primary parameter in the determination of print accuracy among all materials ($p < 0.001$). Higher discrepancies and failures were observed in 0° prints. The least printing failures occurred when the middle of the build plate was used. The highest discrepancies were found in posterior clasps, while the lowest discrepancies were found in palatal straps. Printing in the middle of the build plate does not optimize space usage, but results in the least printing failures.

The study provides clinicians with validated and optimised printing parameters for consumer resins, and further reveals the importance of correct RPD design.



Analysing human behaviour for safety assessment at different traffic environment

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Road accidents are caused due to many faults one of the reason is distraction on or off the road. Distraction is defined as an activity that causes a driver to focus on an activity other than remain focused on driving. Further, these distractions are more prone in the influence zone of the toll plazas, where a number of actions have to be taken by the driver in varying traffic conditions. Too many distractions at the toll plazas hence, study has been taken to study the human behaviour in different traffic states.

For this study, an experimental setup is done in such a way that the ocular behaviour of the driver is captured using an Eye Tracker, and the traffic characteristics are captured with the help of an Unmanned Aerial Vehicle (UAV) drone. Eye tracker data of 15 participants were collected using Tobii Pro glasses-2 with a 100 Hz sampling rate. Traffic data was recorded with 4k resolution and 30 frames per second of frame rate for the peak and off-peak hour in the normal weather conditions. The trajectory of each vehicle is extracted at an accuracy of 0.2s using computer vision algorithm. With the trajectory data, the surrogate safety assessment has been carried out considering Time to Collision (TTC) as SSM.

It is observed that drivers were distracted in the selection of lanes before queuing, recovery zone and merging zone. Drivers were distracted by 5-10% in the diverging zone. Drivers were highly distracted in the recovery zone (near toll) and merging section by 15% and 20%, respectively. The main distraction activities were the opposing-traffic, right-side mirror and vehicle interior in the merging zone.

The present study is a novel approach to study the drivers' distraction patterns and visual attention using an eye tracker in the real field toll plaza facility.



Students' perceptions of a STEM-based curriculum: A phenomenographic approach

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Students can perceive STEM in a number of ways that can affect what they gain from STEM curricula. This qualitative study characterised secondary school students' perspectives of integrated STEM lessons using the theoretical framework of phenomenography, to see how they interpret and conceptualise STEM for now and the future.

Thirteen participants were engaged in guided conversations to collect their perspectives of integrated STEM lessons that they had earlier engaged in. Ten qualitatively different ways in which students perceived STEM were uncovered and an outcome space derived. Participants perceived that they had developed deeper intellectual abilities, collaborative skills, understanding of assigned projects, and professional identities.

The findings of this work would inform a design of STEM curriculum that will improve STEM learning and outcomes in a holistic manner. Implications and suggestions for the design and integration of STEM based on the results of this work are presented.

Keywords: Outcome space, phenomenography, real-world, STEM curriculum, perceptions



Hoiho (*Megadyptes antipodes*) stress and foraging patterns across 15 years at Rakiura

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As top predators, penguins are considered indicators of environmental change. Shifts in oceanic conditions such as temperature and productivity, as well as prey abundance and distribution, are reflected in penguin physiological biomarkers which can help us to better understand population dynamics.

Recent work has shown that feathers can act as an annual bio logger of internal stress levels (via stress hormones) and broad-scale prey types (via stable isotopes) targeted by seabirds. This is particularly important for penguin species of high conservation priority where declines in population numbers are being reported internationally, and birds continue to be subjected to multiple stressors.

In this research we analysed archival feathers collected over 15 years from hoiho/yellow-eyed penguin (*Megadyptes antipodes*) chicks raised around Rakiura/Stewart Island – focussing on prey trophic levels and stress hormones. Specifically, we explored whether any increases in feather corticosterone (CORT) hormone levels and stable isotope ratios ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) were observed, and if this may help to explain the ongoing declines in Rakiura hoiho numbers.

Our findings showed that while significant differences in CORT were found among seasons, there was no steady increase over the 15 years of archived samples. During this time period a slight increase in $\delta^{15}\text{N}$ was observed implying that hoiho are targeting higher trophic level prey in recent years. Interestingly, chick stress levels and colony breeding success exhibited a positive relationship, which now needs to be fully resolved.



It's a weird time to be a woman in engineering

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When we meet new people, and we're doing the usual small talk things, the inevitable question of "what do you do for work?" comes up. When we say we're engineers, the response is usually predictable. An older man might say "Wow, you're really an Engineer?". An older woman might say "Oh wow! What's that like?" A younger man might say "Oh cool! I have a friend that studied engineering". A younger woman might say "Oh wow! That must be hard, I'm not smart enough to do that". These are the perfect example of today's society.

There is the older generation who grew up in a patriarchal society, where men were the breadwinners, and the women were the 'homemakers'; to be a Women in Engineering in this time is rare.

There is the in-between generation who know that this gender imbalance is not ok and try to honour this, but it creeps back in; firstly, because the older generation typically still hold power positions, and secondly, it's tough to change the behaviour that was modelled to you throughout your formative years. To be a Women in Engineering in this time often meant putting aside your personality or femininity in order to get ahead, or sometimes, even just to be taken seriously.

There is our generation who somehow came across engineering at high-school, or a parent, a family friend, or a teacher encouraged us to study STEM. The engineering world is still male dominated, so typically women are encouraged to "grow a thick skin", to "brush it off", or to "take it with a grain of salt". We are told these things while being told that "Diversity and Inclusion is core to the business".

And finally, we have the younger generation, who are the most important part of this conversation.



Zwitterionic cyclodextrin nanocarrier for targeted anticancer drug delivery

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Diverse non-renal-clearable nanocarriers were reported for tumor-targeted controlled delivery of anticancer drugs, yet their off-target accumulation has been one of major challenges, impeding its clinical translation. The objective of this study was to optimize a renal-clearable cyclodextrin (CD)-based nanocarrier for enhancing tumor retention and reducing off-target accumulation.

Twenty CD derivatives with different charge and spacer were synthesized, and then screened for colloidal stability. A fluorescence dye (ACy7) was complexed with CD to evaluate their biodistribution in rats. The optimized zwitterionic CD structure which showed the highest tumor-to-background ratio was selected and complexed with doxorubicin and ulixertinib.

Mass-spectrometric quantitation and fluorescence imaging analysis confirmed that drug-loaded CD-based nanocarrier exhibited enhanced tumor accumulation, facilitated urinary elimination and enhanced tumor penetration effect comparable to those of free drugs. The improved antitumor efficacy of renal-clearable CD-based nanocarrier was demonstrated in heterotopic and orthotopic colorectal cancer models in rats.

These results suggest that renal-clearable CD-based zwitterionic nanocarrier can be applied as a promising nanoplatform for tumor-targeted anticancer drug delivery.



Poultry egg omega-3 fatty acid content from Nannochloropsis supplemented feed

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Due to the cardiovascular health benefits of the omega-3 polyunsaturated fatty acids (PUFAs) eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), federal nutritional guidelines recommend a minimum combined intake of 250–500 mg/d. The traditional dietary sources for EPA and DHA are marine fish, which are not widely consumed and have become unsustainable due to declining global fish stocks.

In contrast, U.S. chicken egg consumption has steadily risen, and eggs can be modified in chemical composition to deliver more nutrients to consumers. Previous studies utilized flaxseed and fish oil as poultry feed supplements to supply precursor PUFAs, which have a low conversion rate to EPA/DHA in the human body. In contrast, this study utilized Nannochloropsis, a marine microalgae that is a promising direct source of EPA/DHA and is both sustainable and efficient.

Results were that poultry feed supplementation with Nannochloropsis produces PUFA-enriched eggs. Fatty acid analysis of eggs showed concentrations of EPA increased from undetectable to 0.30 mg/g (p value=0.02), and DHA increased by 14.5%. Additional findings demonstrated the eggshell density after algae supplementation increased by 26.9% and eggshell thickness increased by 51% (p =0.03), indicating that this supplementation would positively impact physical qualities which are important to commercial shipment of eggs.

These data suggest that egg production from a Nannochloropsis supplemented poultry diet could partially replace conventional EPA and DHA sources and reduce the current reliance on the increasingly unsustainable aquaculture industry without the need for changing consumer behavior.



Using drivers and transmission pathways to identify SARS-like coronavirus spillover risk hotspots

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The emergence of SARS-like coronaviruses is a multi-stage process from wildlife reservoirs to people. Here we characterize multiple drivers—landscape change, host distribution, and human exposure—associated with the risk of zoonotic spillover of SARS-like coronaviruses to help inform surveillance and mitigation activities. We consider direct and indirect transmission pathways by modeling four scenarios with livestock and mammalian wildlife as potential and known reservoirs before examining how access to healthcare varies within clusters and scenarios.

We found 19 multivariate clusters with differing risk factor contributions within a single country (N=9) or transboundary (N=10). High-risk areas were mainly closer (11-20%) rather than far (<1%) from healthcare. Areas far from healthcare reveal healthcare access inequalities, especially Scenario 3, which includes wild mammals as secondary hosts. Clusters with the highest risk scores were located in China (N=2) and Indonesia (N=1).

Our findings can help stakeholders in land use planning integrating healthcare implementation and One Health actions into transboundary, national or subnational levels.



Cyclodextrins as dietary fiber and its application in personal supplements; the study of inter-molecular action by spectroscopy.

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Infrared spectroscopy was applied to determine the orientations of guest molecules in cyclodextrin (α-, β-, or γ-cyclodextrin (CD)). Some bands of the guest molecules were found to shift by several wavenumbers upon formation of inclusion complexes or upon variation of the diameters of CD.

The shifts could be explained by the steric hindrance imparted on the guest molecules in the CD cavities. Moreover, the bands were thought to be due to the vibrations of the moieties of guest molecules in the cavity of CD.

The orientation of a guest molecule in a CD cavity was found to be determined by the charge distribution in the guest molecule; the negatively charged moiety of a guest molecule is attracted to the inside of CD. Moreover we have found that α-CD is effective as not only a dietary fiber but also in reduction of cholesterol absorption in the small intestine by making complex with lecithin.



Value of science and technology to develop and commercialise new ingredients for infant nutrition

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Feeding our most vulnerable little people can be full of joy and a time of anxiety for new parents. When breastfeeding isn't possible then infant formula is the only suitable alternative and parents want the closest product to breastmilk as possible. This drives innovation in the infant nutrition field.

Science and technology is essential for bringing new ingredients for infant formula to market. The category relies on a scientific understanding of infant nutrition, of the composition of human breastmilk, and the nature of infant feeding to guide the development of the best possible alternative.

Accurate measurement of the composition of human breastmilk provides the design targets for new ingredients, however scientific evidence on the nutritional benefits of these ingredients is crucial for regulatory and customer acceptances. Scientific evidence underpins the value propositions of new products – which are ideally aligned to the greatest unmet needs of parents with formula-fed infants.

The infant formula category expects the highest possible standards of food safety and quality to protect vulnerable consumers, and robust science is also critical to support the rigorous regulatory processes involved in commercialising new ingredients in this area.

We will share examples where we have leveraged this knowledge, combined with our expertise in dairy science and new product development, to bring new ingredients to market.



Promoting girls' engagement in STEM through a maiden science fair in a community in Ghana

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Concerns about the low participation of girls in STEM generally, have prompted several affirmative actions in many countries, especially in Africa, with the aim of finding solutions to curb the situation.

Ghana in particular instituted some measures such as the establishment of the Science, Technology and Mathematics Education (STME) clinics for girls, and the girls' education unit in all municipalities and districts in an attempt to promote girls' engagements in STEM. This study, conducted in Winneba, in the Effutu Municipality of the Central Region of Ghana sought to determine the effect of a maiden science fair in promoting the engagement of girls in STEM.

136 girls from all 34 public basic schools in the municipality voluntarily participated in the fair. Data from a survey on the fair revealed that the girls had their interests in the disciplines boosted, were motivated to actively engage in STEM and encouraged to pursue STEM and related careers in the future. Therefore, the study recommended that science fairs should be organised often in the Municipality to increase participation, and sustain the interest of girls in STEM. Furthermore, science fairs should be organised in other municipalities and districts in the Region and beyond to help promote the participation and interests of girls in STEM and related fields.

Keywords: Science fair, STEM, Girls' engagement, STEM participation, Girls' interest



Rural girls in STEM education: perceptions, participation and future career

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The low participation of girls, particularly those living in rural areas in science, technology, engineering and mathematics (STEM) in many countries across the world, has been a cause of concern for many stakeholders in the field. With the ratio of males to females in the fields of STEM almost always skewed in favour of males, this study sought to investigate the perceptions, participation and future career aspirations in STEM of girls living in rural areas in the Effutu Municipality of the Central Region of Ghana.

The authors used a questionnaire to solicit the participants' perceptions about their study of STEM. A focused group interview was also employed to elicit the views of the girls on their participation in the study of STEM as well as future career plans they had towards further education in these disciplines. This was a qualitative study in which all 31 girls in three basic schools in the rural areas of the Municipality were purposely sampled to participate in the study.

The findings revealed poor participation of the girls in their study of STEM, leading to negative perceptions towards the disciplines. However, the girls had positive future career plans towards STEM and related disciplines.

The study recommends that the everyday experiences of learners should be inculcated into the teaching and learning of STEM, to contextualise concepts in order to encourage the learners' active participation and interests. This could lead to positive perceptions towards learners' study of STEM and continually motivate them to pursue STEM and related careers.

Keywords: students' perception, students' participation, future career, STEM, rural girls



Red Wine Lees are a potential dietary source of antioxidants

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Grape wine lees are the residue formed at the bottom of wine containers, after fermentation during storage. Red wine lees (RWL) typically contain yeast autolysates, insoluble carbohydrates (such as cellulosic or hemicellulosic materials), inorganic salts, lignin, proteins as well as precipitates of tannins, phenolic compounds and organic acids (mainly tartaric acid). At present RWL have limited use as an additive in food production and some chefs have used them as a cooking ingredient. RWL have the potential to become health products, diverting from the waste stream.

The first part of this study determined the detailed composition of New Zealand Pinot noir RWL. Three samples from 2019 and 2020, Marlborough and Central Otago regions, made with different techniques were analysed. A second stage involved putting the samples through an in vitro digestion system simulating gastrointestinal conditions to assess bioavailability. Compositional analyses were carried out to determine the major components, followed by a targeted analysis of selected metabolites related to anthocyanin groups.

Over 700 features were detected in the three samples and their corresponding digesta samples, and at least 84 different metabolites were identified belonging to polyphenolic groups, fatty acids and derivatives, sugar and sugar derivatives, phenolic acids and other organic acids. The study found that polyphenols were often released during in vitro stomach digestion and then reduced during ileal digestion and dialysis phase, but this was dependent on the polyphenol compound type. Based on the large amount of data collected, it can be concluded that RWL from Pinot noir have the potential to be a dietary source of antioxidants. The analysis of bio-actives present in wine lees, particularly anthocyanins at different stages of digestion has helped determine the potential bioavailability and health benefits of wine lees.



New directions in science education: expectations for the contributions of women scientists

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In Japan, education strictly follows the "Courses of Study" of the Ministry of Education, Culture, Sports, Science and Technology, which are revised almost every 10 years. The most recent Courses of Study lists "enhancement of science and mathematics education" as one of its priority items. Despite the fact that Japanese children's science literacy is among the highest in OECD countries, they are "turning away from science" (TIMSS 2019).

To increase interest, it is important to relate it to the most familiar events and to oneself, but for example, heredity education in Japan does not teach about human heredity in secondary school textbooks, making it difficult for students to see heredity as something close to home. This is true for science in Japan in general, and in order to interest people in science, we propose 1) a multifaceted view of science that integrates humanities and sciences, not just science fields (STEAM education), 2) incorporating more scientific concepts into education, and 3) increasing the number of female scientists and adding women's perspectives to science. Regarding 3), SJWS has begun an experiment to build a new program of STEAM education, in which students can pay attention to and scientifically understand their own mind and body through "body-mind unification science."

It is known from research that women are better at processing and thinking about the relationships among many things at the same time, and an integrated understanding of the scientific knowledge that has been accumulated is essential to meet the new challenges of the Society 5.0 (a society that is centered around smart technology) era. We look forward to the power of women scientists to contribute to novel innovations.



Activities of the Society of Japanese Women Scientists

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The Society of Japanese Women Scientists (SJWS) was established in April, 1958 to foster friendship among female scientists, facilitate knowledge exchange among them in various fields of research and provide support during their career with the ultimate goal of advancing world peace. The establishment of SJWS was wholly supported by the Committee of Seven for World Peace Appeal initiated in Japan in 1955, which included Raicho Hiratsuka, the vice president of the Women's International Democratic Federation and Hideki Yukawa (Nobel Laureate in physics in 1949) and SJWS hosted ICWES11 in 1999.

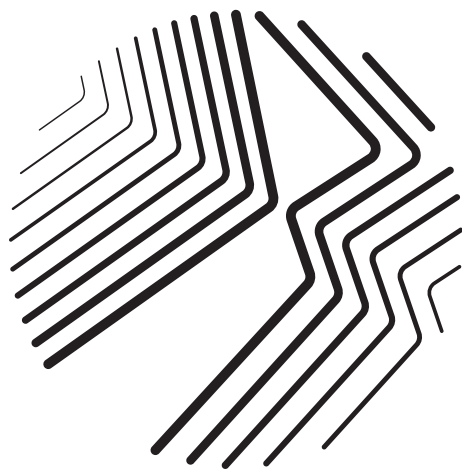
Since 2014, SJWS has become the general incorporated association. SJWS members are researchers and engineers in the STEM field, mostly from universities and public research institutes. SJWS welcomes male members and currently, one of the directors is a man. Since its founding, SJWS has been committed to improving the environment and promotion of women scientists, and has actively held scientific lectures and symposiums focusing on issues facing women researchers.

Since 1995, SJWS has annually presented two awards to scientists who have made great contributions to advancing the objectives of SJWS: 1) Early Career Investigator Award to encourage and acknowledge excellence in science, and 2) Distinguished Service Award to recognize outstanding service to scientific community.

The proportion of female researchers in Japan is 16.9% in 2020, of which less than 18% hold a PhD: the proportion of independent researchers is extremely low. The government has set a goal of increasing the percentage of female researchers employed at universities and public research institutes in the natural sciences to 30% by 2016, but as of 2022, that goal has not been achieved.

SJWS will continue to improve the environment for female researchers and support their promotion, as well as work to establish a system that allows female researchers to continue working.





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