NZASE scientist profile

Nancy Garrity

Born where and when

Tāmaki Makaurau, 1978

Affiliations

Ko Taupiri te maunga, Ko Waikato te awa, No Ngāti Makirangi me Ngāti Pāoa, o Tainui me Ngāti Hine o Ngā Puhi ōku tipuna.

School subjects

Biology, Chemistry. "My teachers didn't teach out of a book, so we learnt about pair bonding and the honey bee waggle during the ball season, and about anions and cations using a Stars Wars analogy."

How she got into science

"I'm Whoovian at heart (the Dr Who whānau know), and prefer *Star Trek* over *Star Wars*. I've always been really curious about how our world works and why. I was the kid who was always asking questions, always getting told off for touching things. I was haututū as. Luckily I found the library during primary and secondary school – shout out to encyclopaedias. I also read the Kay Scarpetta series through high school and thought that forensics and pathology would be cool."

"I don't sit still very well, and science is a job that allows so much variability day to day – I can be writing and planning in the office, out to the field collecting data, or analysing that data in the lab."

Training and jobs

BSc in materials and process engineering, **MSc** in materials science, University of Waikato; **Bachelor** of Iwi Environmental Management, Te Wananga o Aotearoa; **PhD** in polymer chemistry, University of Auckland.

"I worked at Scion in Rotorua for 12 years as a materials scientist, developing and testing bio-based composite materials, then as a research scientist on the West Coast."

Nancy works at the Institute of Environmental Science Research (ESR) in Ōtautahi. She was the Pou Pūtahitanga - Manager Ao Māori-Science Interface, "an advisory role with our scientists to increase their awareness and build enduring partnerships with Māori". She is now Kaihautu Wai Māori – Lead for He Wai Mapuna programme. She develops research and strategies that lead to "a balanced collaboration of mātauranga and science from an Ao Māori perspective".

Fields of science

Materials Science – "The multi-disciplinary study of stuff (e.g. wood, metals, ceramics, plastics) and its properties, understanding why materials behave the way they do".

Polymer Chemistry – "The science of stitching together small units of chemicals to make larger groups that influence their look and behaviour (plastics are polymers). Scientists build new materials on a microscopic scale, and materials science then understands their properties, behaviours and applications."

Research examples

Metallurgy

Nancy's earliest research looked at extracting titanium metals and alloys from waste materials in steel making.

Plastics

Nancy studies how to incorporate plastics grown from microbes with the natural

strength of harakeke and tī kōuka fibres, as possible plastic substitutes. “Traditionally, our tīpuna used harakeke and tī kōuka for ropes to bind waka, footware and rain capes. This research applies traditional Māori knowledge to create bio-based alternatives to plastic.”

Bio-based adhesives

This research used chemicals extracted from chicken feed, wood and bark to develop bio-based adhesives strong enough create MDF, particleboard and plywood. Nancy studied the contribution of each chemical to the strength of the final product, as well as how temperature and pressure causes the adhesive to flow, spread and cure. She developed enough of the compound to fill a coffee cup in the lab, and then trialled scaling it up to five tons.

Minerals to materials

“The South Island’s West Coast is home to many high-value minerals, none more valuable to Māori than pounamu. Working with Ngāti Waewae, this research mixed pounamu waste from carving with plastic extracted from corn sugars to create 3D printable materials.”

How she find things out

‘Cooking’

“Developing new materials is similar to cooking food – understanding which chemicals will work well together and those that won’t, to get the result you want. The scale at which material scientists work is broad and usually starts at a few grams, builds up to a number of kilograms, potentially producing tonnes; we need to understand how the recipe changes with size.”

Ngā Kupu

From Te Aka Maori Dictionary and Paekupu

Haututū – Mischievous
Hiato – Composite
Mātai matū – Chemistry
Mātai wetekupu – Morphology, structure
Ōwehenga matū – Chemical composition
Rawa māori – Natural resource
Hangarau rawa ōkiko – Materials technology
Waerau – Polymer.

Nancy, centre, with Leilani Rickard (left) and Anastasia Rickard in the Scion lab, holding polymer/fibre composite samples ready for tensile strength testing. Photo: National Science Challenges.

Curious trial and error

“This starts with wondering ‘what would happen if…’ Then we think of possible theories or answers, according to existing research and our own knowledge. Then we test some of those theories in the lab, understanding what’s going right and wrong, trialling until we get the answer we want.”

Strength testing

“This is fundamental to understanding potential uses for materials. Strength means different things, depending on the type of force applied. If a material is being squashed, pulled or hit, it responds differently - compare marshmallows and toffee.”

Thermal analysis

“It is critical to understand how a material behaves at different temperatures, because it effects how easy it is to produce and it’s potential uses. For example, moulding plastics into different shapes means understanding the best melt temperatures to get it to flow into shape without burning. Some plastics don’t like cold temperatures and will shatter, so you wouldn’t use them for freezer bags!”

Most valuable results

1 “My work studying the potential of indigenous fibres as reinforcing materials in polymer composites has been incredibly

Nancy exploring the properties of tī kōuka at a Landcare/ Manaaki Whenua plantation in 2020.

valuable. It starts with a Māori lens, alongside mātauranga experts. We studied culturally significant fibres, including tī kōuka, kiekie and pingao, and found that harakeke is the only plant where the higher quality fibres sit on one side of a natural fracture line. That is due to its consistent structure (consistency is rare), and makes extracting the fibre easy and reliable. It also supports why our tīpuna harvested harakeke fibres for so many uses, rather than the alternatives."

2 "Working with bio-based adhesives is interesting because nature is inconsistent, unlike synthetic chemicals that are tailored, replicable and consistent. Plant species have different structures, chemistries and biology. You'll also see differences between plants of the same whānau, and that tiny difference can create a completely different material. So material scientists need to change our understanding of precision and tailor our methods to suit."

3 "Heating from 50g to 5kg of an adhesive in the lab is standard. But when we start producing tonnes, we need to think of the energy and time needed to heat and cool that amount, what big equipment we need to hold and mix those ingredients, and how to fix it if it goes wrong or gets stuck in the equipment. There were a few hairy moments, but it's really satisfying to see industry interest."

Mātauranga Māori

"I've grown up with specific Tainui tikanga about my responsibility to our taiao as whānau. We mihimihi to our whenua, awa and maunga, and I was taught kaitiakitanga and taonga tuku iho. It was pretty surprising to learn at university about environmentalism and sustainability as if these were recent concepts!"

Nancy says that science research has gradually changed from using Māori only as advisors, to Māori leading projects or tauiwi scientists working with active Māori partners.

"Mātauranga and te ao māori set our science apart from the rest of the world. Research on natural resources starts by working with our people who have an 800-year head start understanding Aotearoa's resources. Excitingly, my new mahi integrates mātauranga, te ao māori and science from the perspective of Māori, understanding that what's good for Māori is good for all New Zealand."

What she likes about science

"Science soothes the quirky kid who couldn't sit still, who was always asking questions, and who now gets paid to find answers. My work has a lot of freedom and self-management, allowing me to plan how and where I'll spend my day. I'm grateful that science took me around the world to see how other people view their environments. And I love the ability to search for answers to questions that have real benefits for our people."

Links

- Science for technological innovation challenge; Dr Nancy Garrity [Article + three 2m videos].
- Manaaki Whenua/Landcare Research, 2020. Māori and Polynesian textile plants [Facebook post + photos].
- IRANZ, 2020, NZIMMR Green to Gold project awarded Vision Mātauranga funding [Short article].