NZASE resource

Atua and the periodic table

Ruihi Shortland is the teacher in charge of science within the Rumaki at Auckland's Western Springs College. She recently completed her PhD in Indigenous Studies on a Māori Interpretation of te taka pūmotu, the periodic table, and shared with us some of her learning. By NZASE Science Communicator Mike Stone.

Ranginui and Papatūānuku, by Michelle Estall

Ruihi was reared in Whakatāne by her grand-parents, Poirangi Tua Shortland of Ngā Puhi, Ngāti Rehia and Meri Hekiheki Wikeepa Shortland of Ngāti Awa, Te Patuwai. Ruihi acknowledges all the tohunga Māori and science experts she had the privilege of learning from.

Ruihi's research explores the relationship between Pūtaiao and Western science and the challenges to science education that embrace both atua Māori and science concepts like the periodic table.

Her thesis discusses how Māori concepts such as whakapapa, karakia and kōrero pūrākau (stories) provide a useful structure for Māori science and pedagogy; and explores how kaupapa Māori and mātauranga Māori influence this teaching. It asks: How can we explore scientific examples like the elements of the periodic table through a Māori worldview?

Mātauranga Māori

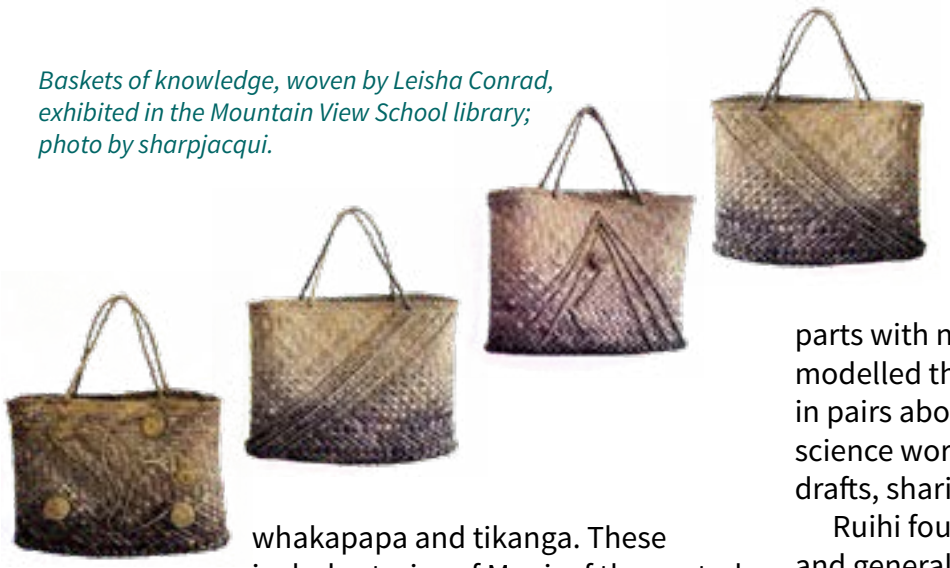
Mātauranga Māori is about a Māori way of knowing, a very broad knowledge base that encompasses the sciences as well as "philosophy, mathematics, language, history, education" and others. It is bound by tikanga (protocol) and pono (truth) and some knowledge is tapu (sacred), tying mātauranga Māori firmly into Māori beliefs and values. Mātauranga Māori can be expressed in kōrero pūrākau, karakia (prayer) and whakapapa, as well as mōteatea, waiata, and more – mātauranga and te reo are closely bound.

When we use Mātauranga Māori today to enhance relationships between people and the environment, we enact kaitiakitanga (guardianship), underpinned by the values and principles of mana, mauri and whānaungatanga.

Many iwi have an oral tradition about Tane retrieving three baskets of knowledge (Ngā Kete E Toru o Te Wānanga) from the heavens, though each iwi tells the story differently. Ngāti Awa say Tāwhaki received four baskets of knowledge. Pouroto Ngaropo, an astute tohunga of the iwi, describes the kete: "Whēkite consists of the knowledge pertaining to karakia and whakapapa. Whēkaro consists of the knowledge we learn in life, from the time we are born to the time we take our last breath. Te Werohia consists of all things that are negative. Te Whakairihia is the basket of knowledge and wisdom."

Kōrero pūrākau

Kōrero pūrākau are an important way of transmitting mātauranga Māori, history,



Baskets of knowledge, woven by Leisha Conrad, exhibited in the Mountain View School library; photo by sharpjacqui.

whakapapa and tikanga. These include stories of Maui, of the central North Island volcanoes, of taniwha, and more. Kōrero pūrākau also have a teaching and learning (ako) element, and require an open mind to understand their morals, principles, values and beliefs.

Ruihi recounts a PD workshop on culturally responsive pedagogy where 'myths and legends' were being discussed. I was there too. A teacher said "No one believes in that anyway", to which Ruihi responded, "I do, and when things like that are said, you switch our Māori students off science."

I remember this as a powerful moment in the workshop – for me it was about realising the impact of a lack of respect for other kinds of knowledge. From then on I talked about kōrero pūrākau, rather than myths and legends, in a different way.

It is important not to use the tools of one form of knowledge to analyse the foundations of another. Science stories and kōrero pūrākau serve different purposes and need to both stand alone. For all students we can draw on kōrero pūrākau to help bring understanding before going into the specifics of the science. For Maori students, pūrākau make a real connection and allow teachers to draw out and build on their knowledge, for example by inviting students to find out and tell the story, and link it to the associated atua.

Story-telling example

Ruihi has explored narratives as a teaching tool, a bridge between scientific language and the cultural knowledge Māori students bring to their learning. She gives the example of asking students to write the story of a tomato pip travelling through the gut. First the class discussed the parts of the gut, in English and te reo. Next students drew a body outline, labelling the digestive parts with name and function. After Ruihi modelled the writing process, students wrote in pairs about the tomato pip's journey, using science words and concepts. They did several drafts, sharing their story with their peers.

Ruihi found students could write more and generally used more science terms with this collaborative approach. Students reported enjoying this kind of writing and the opportunity for creativity, and found it helped them remember the science.

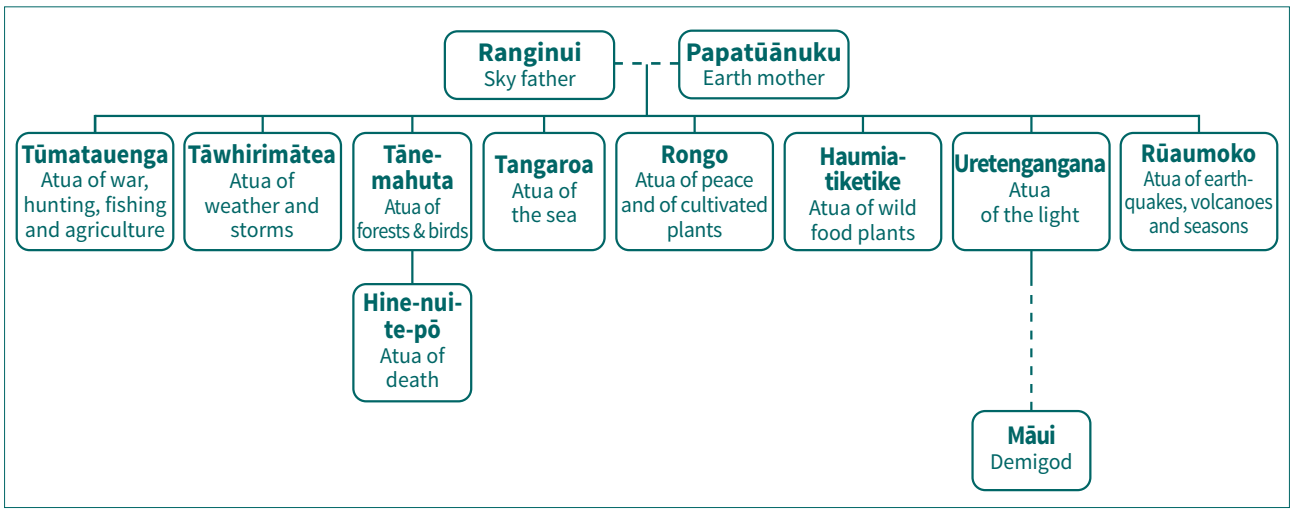
Karakia

Mātauranga Māori is also expressed in karakia. There is a traditional karakia that has embedded within its phrases the elements with their life-giving energy. The whakapapa connects us through the taiao (natural world) to the children of Ranginui in the heavens and of Papatūānuku on the earth. Strands of energy connect the elements between sky and earth. The energies come from a life force (mauri), from a great distance, from the millennium that are gathered from the atua. The forces are described as the kaitiaki of the forests, kaitiaki of the energies for fire, and they are connected over great distances through the winds (hau).

Whakapapa

Mātauranga Māori can also be expressed in whakapapa. Historically, whakapapa were passed on orally, carefully safeguarded by elders. These genealogies are intricate, detailed and complex, a means of ordering and retaining knowledge.

From the beginning of creation, to the children of Ranginui and Papatūānuku, and descending to our ancestors, all aspects of creation have whakapapa – the cosmological space, animals, plants, land, water, including whakapapa of the seen and unseen. This allows us to consider whakapapa for each of



Simplified whaka-papa o ngā atua.

the elements on the periodic table.

Ruihi used all these forms of knowledge – whakapapa, kōrero pūrākau and karakia – to develop the whakapapa of the elements. Just as Pākeha scientists talk about word derivations (e.g., hydrogen's original meaning was 'generator of water'), so too do Māori (e.g., the name for hydrogen is hauwai, meaning 'water vapour').

Ngā atua and te taka pūmotu

Māori have always been actively and effectively engaged in taiao, the natural environment, guided by atua Māori. All of the elements of Pūtaiao could align to realms of atua Māori; elements found in earth to Papatūānuku, gas elements to Tāwhirimātea (atua of winds and weather), and volcanic elements to Rūaumoko (atua of earthquakes).

El	Name	Meaning	Atua in whakapapa
H	Hauwai	Gas derived from water	Tāwhirimātea, Tangaroa, Hineteiwaiwa
He	Haumāmā	Lightweight gas	Ranginui, Papatūānuku, Tāwhirimātea
Li	Konukōhatu	Solid in a specific rock	Papatūānuku
Be	Konuuku	Solid found in clay	Rūaumoko, Hine-puia, Hine-uku
B	Pūtiwha	Solid that gleams	Tāne, Hinetītama, Hinerauwharangi, Hineteuira, Hinerepo, Hinepūkohurangi, Hinenuitepō, Rehua-kai-tangata, Tūmatauenga, Tamanuite-Rā, Ruatoia, Ruakumea
C	Waro	Burning, coal, charcoal	Papatūānuku, Mahuika
N	Hauota	Gas derived from plants	Tāwhirimātea
O	Hāora	Breath needed for life	Tānemahuta, Tāwhirimātea, Hineahuone
F	Haukōwhai	Yellow gas	Tāwhirimātea
Ne	Haukura	Red, glowing gas	Tāwhirimātea
Na	Konutai	Metal from the sea	Ranginui, Papatūānuku, Tāwhirimātea rātou ko Tangaroa
Mg	Konupora	Metal like a white stone	Papatūānuku
Al	Konumohe	Soft, yielding metal	Papatūānuku
Si	Takawai	Quartz, water	Ranginui, Papatūānuku, rātou ko Tangaroa
P	Pūtūtaewhetū	Phosphorescent substance	Ranginui, Papatūānuku, Tangotango, Wainui, Uretengangana, Hineturama
S	Pungatara	Traditional name	Rūaumoko
Cl	Haumāota	Green gas	Ranginui, Papatūānuku, Tāwhirimātea, Tāne Mahuta
Ar	Hauhauhā	Gas	Tāwhirimātea
K	Konurehu	Spray, fine dust, solid	Papatūānuku

Te Tauihu Putaio, the prow of the science waka, carved by Rangi Hetet of Te Atiawa and Sonny Davis at Waiwhetu. The carving is housed at te Whare a Māui, the Māori Innovation Hub at Callaghan Innovation in Lower Hutt.

Ruihi also studied mātauranga about a further 20 elements.

The conventions employed to name elements of te taka pūmotu include using the prefix konu to represent solids derived from Papatūānuku; hau to represent elements derived from gases; using a property of the element; and in some cases a transliteration of the element's English name.

When we tell the story of specific elements' names we can make links that allow all students to build on what they already know.

Tohutoro / references

Shortland, L.R. (2019). *A Māori Interpretation of the Periodic Table.* Unpublished PhD thesis.

Shortland, L. R., & Locke, T. (2018). The Tomato Pip's Story: Creative narratives as bridging cultural and science discourses for indigenous students. *The Australian Journal of Indigenous Education, 47*(2), 171-184.

Te Ara. *Te whare tapere*.

Rauemi matihiko / resources

Posters of atua are available from Ako Learning Resources.

Ngā Kupu

Atua – Gods
Mana – Authority, control, influence, power, prestige, psychic force
Mauri – Life essence, life force
Mōteatea – Lament, traditional song
Takutaku – To recite karakia
Taniwha – Water spirit, powerful creature, may be guardians or malign
Tohunga – Chosen expert in a field of knowledge
Waiata – Song; to sing
Whakapapa – Genealogies
Whānaungatanga – A familial relationship through kinship

From Te Aka Maori Dictionary