VIEWPOINT

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COLUMN

Bringing the field to the classroom

Interactive Earth science gardens on campus can break down barriers to field learning, says Kate Pedley

Spatial skills are a critical competency for success in science, technology, engineering and mathematics, and are a non-negotiable in geoscience (McLaughlin & Bailey, 2023). Field teaching is an integral component of undergraduate geoscience education. Yet, teaching spatial skills and testing 3D visualisation ability through repeated and sustained access to field sites often comes with a variety of financial, environmental and personal challenges (Jolley et al., 2023).

In April 2025, my colleagues and I formally opened an interactive Earth Science Garden at the heart of the University of Canterbury (UC) campus in New Zealand. Our experience demonstrates that 'rock gardens' can be much more than eye-catching displays – they can engage a wide range of learners and provide valuable preparation for fieldwork.

Rethinking rock gardens

The design and development of the UC Earth Science Garden began back in 2016 with the near completion of the Rutherford Regional Science and Innovation Centre, following the devastating Christchurch earthquakes sequence in 2011. Originally, a rock display garden was proposed, but I felt that rocks just sitting on the grass might reinforce the stereotype that all geologists do is look at rocks. It certainly wouldn't connect with or inspire non-geologists, plus it would have limited real opportunities for teaching. Additionally, the new building was earthquake-proofed with steel reinforcement, meaning that the compasses so often used in classrooms to introduce students to basic field skills were no longer able to find north! I sensed an opportunity to rethink the traditional rock garden.

As a structural geologist and field teaching specialist, I feel strongly that innovative pedagogical approaches can make studying geology more future-focused and fun, while equipping students with work-ready skills and the ability to solve interdisciplinary spatial and temporal problems. Weaving together cutting-edge digital technologies and tactile authentic experiences, while removing distance and barriers to learning, can make geology tangible and relevant for students, deepening understanding and igniting curiosity.

So, I researched interactive Earth science gardens around the world. Such gardens can provide students with the opportunity to physically practice and enhance 3D visualisation to understand geological relationships and basic field techniques. Plus, students can collect a variety of qualitative and quantitative data that can be further analysed by laboratory methods and digital visualisation tools (Dillon et al., 2000; Benison et al., 2005; Waldron et al., 2016; Wong Hearing et al., 2024).

> “I sensed an opportunity to rethink the traditional rock garden”

I discovered great inspiration from the Geoscience Garden at the University of Alberta, Canada, and the award-winning Earth Sciences Garden at Monash University, Australia, as well as from the geology academics involved with designing these projects, who were so generous in giving their time and resources to help inspire my concept for the UC campus design.

Relishing the opportunity to design something unique for the UC garden, I decided to create a real-life puzzle map of key landscapes from New Zealand's South Island for students to solve.

A living laboratory

Today, the UC Earth Science Garden is New Zealand's first and one of very few map-based teaching rock gardens worldwide (Wong Hearing et al., 2024). Working with quarry owners, Māori advisors, UC staff and contractors, more than 200 rocks representing 15 key South Island lithologies

Students can get creative with an interactive volcano to learn about lava flows

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FIND OUT MORE
About the Earth Science Garden at the University of Canterbury, New Zealand, by visiting: canterbury.ac.nz

were hand selected, some weighing over six tonnes.

I've arranged them as a walk-through miniature of Te Wai Pounamu South Island, particularly focused on the Canterbury and West Coast regions. Greywacke belts flank schist from the Southern Alps and the Alpine Fault trace bisects the garden, offsetting the unique rock dunite (a climate-change fighting rock that absorbs carbon dioxide from the atmosphere and also becomes our most treasured rock pounamu, or greenstone, through metamorphism). Large spherical concretions hold the bones of ancient marine reptiles, and our local Banks Peninsula is represented by an interactive mini volcano. This turns the campus lawn into a permanent living laboratory, starting with the rocks and then layering on native and endemic plant species representative of the regions.

We are also weaving in representations of surface processes and cultural and historical narratives, including engaging art installations (exploring geological time and folds for stereonet analyses with 3D printing) and displays of cores extracted when a ground-source heat pump was installed at the site prior to creating the garden. This pump also provides innovative heating and cooling capacity to the entire science area.

Geology for all

Pedagogically, the garden solves three persistent problems: (1) limited field hours in a crowded curriculum; (2) unequal access for students with financial, mobility, or caregiving constraints; and (3) the steep learning curve of translating textbook diagrams into real outcrop geometry. Because the rocks sit minutes from the lecture theatre, I can embed practical, tactile exercises into labs and set self-directed mapping challenges that students tackle between classes.

The garden offers flexible 24/7 access for students juggling other commitments and enables learners with mobility challenges to still get authentic outcrop experiences without the steep hillsides. The increased opportunity to practice field skills also frees up time during off-campus trips for higher-order interpretation and critical thinking. Use of the site is not restricted only to university staff and students; it is already popular with schools and community groups, with numerous educational activities and resources in development, pitched at a wider audience.

I've been conducting school outreach programmes and events for many years now, and every time I start with the question: what do geologists do? By far the most common answer is "study rocks". What's novel about the UC garden is that it challenges this persistent stereotype, which unfairly simplifies and misses the point of what we study far more holistically – Earth and how it works through deep time. This is arguably a much more exciting concept for attracting and inspiring young minds.

At a time when many geoscience departments face cuts or closure, a rock garden may seem unfeasible for many. However, while it hasn't been easy, the UC garden proves what it is possible with time and dedication. We received no government, industry or sponsor funding; instead, quarries donated rocks, and I purchased some via a partnership between our School of Earth and Environment and the UC Facilities Management. The UC garden has cost tens of thousands of New Zealand dollars so far, compared to the award-winning one at Monash University costing millions of Australian dollars.

The key factors that made the UC garden viable were: building relationships to pitch the dream, emphasizing interest to non-geologists; approaching quarries early and stockpiling rocks; in-house landscape design, which limits the size of rocks and angles you can install them at, but saves money on architects and engineers; use of existing faculty expertise (such as my art and design background to create our website and on-site signage). An initial, small project can attract investors allowing expansion of the project over time. So, I strongly recommend exploring the possibility of creating such a garden – even on small →

scale – should funding or opportunity arise. Alternatively, geology departments can take advantage of existing local Earth science gardens as unique teaching resources.

The professional geoscience sector is predicted to face a severe shortage of skilled workers in the near future (Boone et al., 2021; Keane, 2022). We need to actively address the visibility of geology as a rich and rewarding career path, fundamental to many other disciplines, and vital for the sustainability of living with our planet. Interactive Earth science gardens offer one creative approach for connecting with and engaging the next generation of geoscientists.

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FURTHER READING

A full list of further reading is available at geoscientist.online.

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COLUMN

Earth twin needs geoscience

As society turns to Earth Digital Twins for decision-making, geoscience must play a defining role, urges Pankaj Mishra

A digital twin is a live, virtual version of something real. It updates as new data arrive and lets us test "what if?" questions, exploring the consequences of choices before they are made. An Earth Digital Twin (EDT) applies this idea to our planet: a virtual, data-driven replica of Earth's physical systems that helps us model and test scenarios, thereby enabling better decision-making across science, industry, and policy.

Geoscientists have been making digital Earths for decades. From outcrop to deep crust, we have mapped and modelled the lithosphere, integrating observations with numerical models to explain and predict behaviour. These efforts support decisions on natural resources, infrastructure, and hazards. They are exactly the kind of knowledge Earth Twin initiatives now claim to need. So why are geoscientists not at the centre of the conversation?

Segmented approach

Building a single twin of the whole planet that includes everything and serves every purpose is nearly impossible. Instead, modular efforts are under way for climate, atmosphere, and water, including DestinE in Europe and Earth-2, which is being built by NVIDIA in the USA. As a solid Earth geophysicist, I find these projects inspiring but frustrating. Geology and geophysics are barely visible in them, and national surveys are often absent, even where their data and expertise would be decisive.

A digital twin of the lithosphere would not compete with these efforts, it would complete them. Built from geoscientific observations, physics, and machine learning, it could evolve independently while staying interoperable (Mishra, 2025), so that advances in one domain immediately benefit the others. This is urgent because society's choices increasingly depend on the ground beneath us: critical minerals, geothermal energy, groundwater, safe CO_2 storage, stable transport routes, and even space-weather risks to power grids—all rely on accurate and credible subsurface knowledge.

At the same time, geoscience is shrinking in universities. In the Netherlands, Vrije Universiteit Amsterdam plans to close its Earth Sciences department (vu.nl). In Australia, closures and mergers have been widely reported (timeshighereducation.com; Nat Rev Earth Environ 2, 2021). When budgets tighten, subjects out of sight are first to go. It's possible that many decision-makers still see geoscience as optional. The reality is that no credible path to net zero or resilient infrastructure can bypass the subsurface, which silently supports everything built above it.

Amplify geoscience

We need sharper, louder science communication by geoscientists highlighting the societal importance of our research at every opportunity we get. Geoscientists should follow EDT developments closely, share our insights more widely, and ensure that the lithosphere has a central place in these global initiatives. The future credibility of Earth Twins depends on it.

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FURTHER READING

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