

LOOK DOWN

Process Report

Design with Data

- Ecologies Group 2-

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Introduction

I hurriedly chained my bike to a post and walked up to Salisbury Crags, where the rest of the group were already gathered against the January cold. Even before reaching the site, the route there had begun to frame our thinking: the ‘Innocent’ Railway Path cuts through volcanic bedrock beneath Arthur’s Seat, linking the city above to older industrial histories below.

As we climbed, the first obstacle to our fieldwork appeared: high fencing blocked access to the famed Hutton’s Section (Figure 1), where James Hutton used the dolerite of Salisbury Crags to argue that this rock had once been molten, some 325 million years ago (‘Edinburgh’s Geological Sites’, 2024). We continued upward instead and, from a high point, found ourselves looking across three worlds at once: the city in front of us, the windswept rock beneath us, and the steep valley behind us thick with shrubs and trees. We sketched until our fingers froze.



Figure 1. Radical Road closure fencing at Salisbury Crags. Source: authors.

Starting from Salisbury Crags, and drawing on theories of the more-than-human world (Abram, 1997), this report traces our team’s engagement with deep time, ecological entanglement, and the microbial communities inhabiting the soil beneath the site. Through fieldwork, experimental making, and iterative design, we developed *Look Down*, an installation that shifts attention from visible landscape to hidden underground ecologies. This report reflects on how local context, ecological rhythms, and material experimentation shaped that final design outcome (Murphy, 2016; Ecologies Group 2, 2026).

Multispecies Ethnography

Returning to the temporal ontologies booklets produced during our first climb up Salisbury Crags (Pschetz, 2026), we began to recognise anthropomorphic and anthropocentric tendencies in our early observations. As shown in Figure 2, our sketches were dominated by what was most visible and readily framed as significant: the rock faces, already protected by human infrastructure and entangled with narratives of scientific “Enlightenment” through James Hutton’s work (‘James Hutton: A timeless legacy’, 2022). Gorse appeared to us as “brave” for flowering in midwinter, while thyme “stoically” eroded bedrock. The centres of our diagrams were occupied by large, visible more-than-humans, while many of their relations remained unseen and had to be researched later.

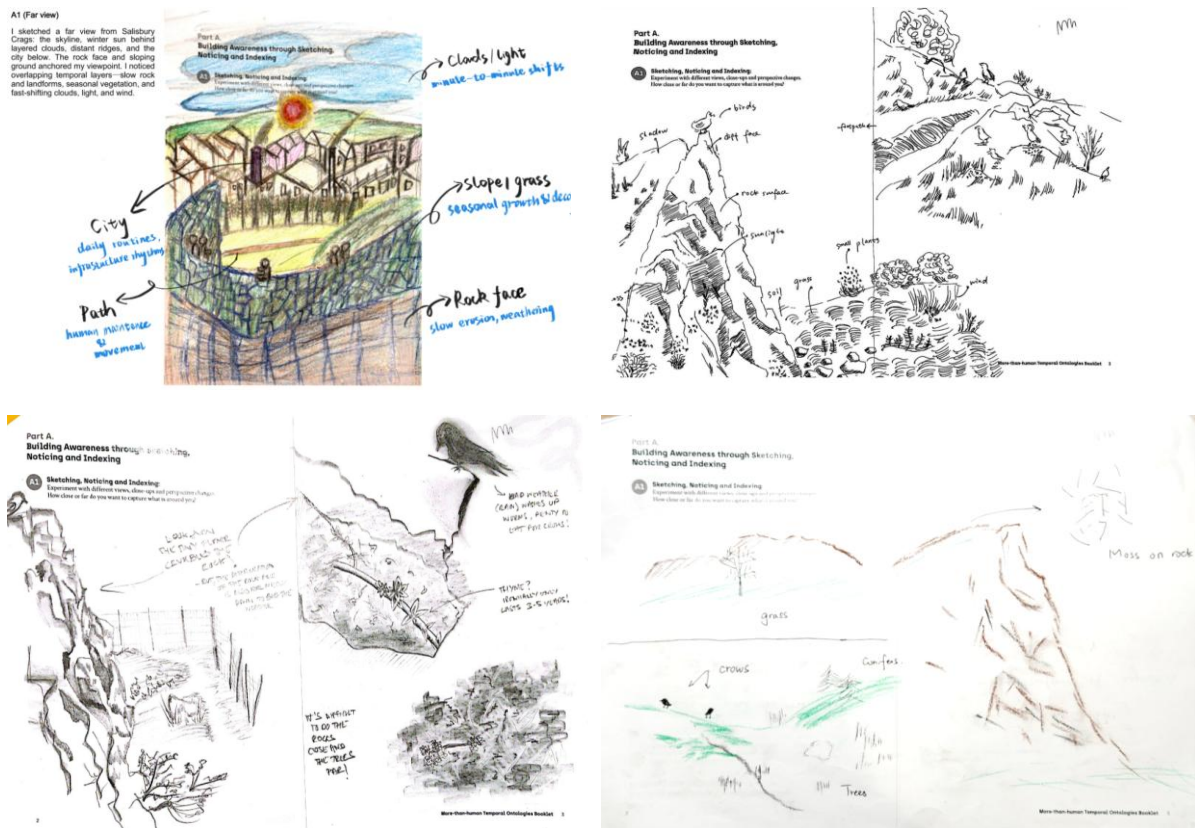


Figure 2. Initial sketches from the temporal ontologies booklets. Source: authors.

Looking back, these notes reveal how partial our first encounters were, shaped by visibility, scale, and the limits of situated attention. As reflected in Figure 3, the booklet drawings became valuable not only as field records but also as evidence of those methodological limits.

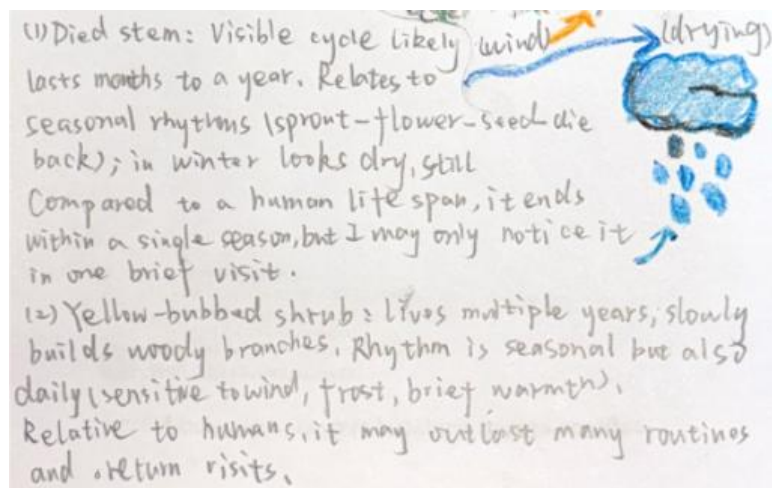


Figure 3. A team member's reflection on possible encounters between two more-than-humans with different temporal rhythms, from the temporal ontologies booklet. Source: authors.

Like Hutton, it was the rock that first drew our attention to deep time, and this orientation is visible in our early fieldwork notes (Figure 4). From there, however, we began to wonder about more-than-humans spanning both familiar and incomprehensible temporalities, such as mosses, which are at once our contemporaries and ancient life forms. Mosses first populated bare rock around 550 million years ago, when our bacterial ancestors were tiny and short-lived (Lueth and Reski, 2023). This shifted

our perspective from a rock-centred reading of the landscape towards a broader awareness of hidden microbial ecologies beneath the surface.

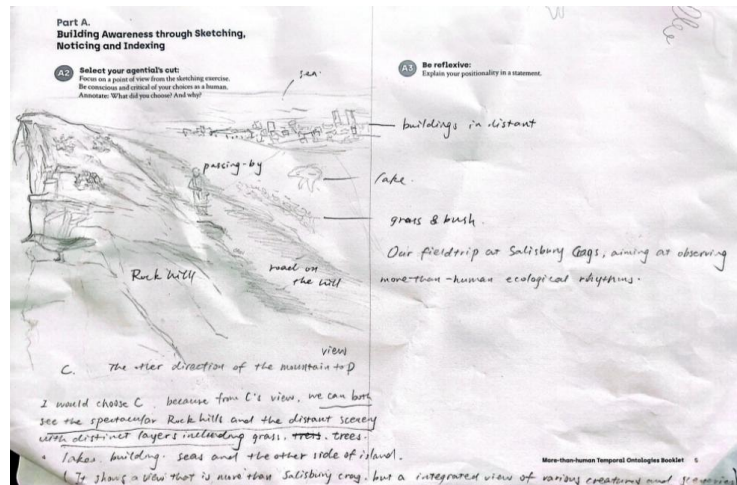


Figure 4. Reflections on our early rock-centric agential cuts during fieldwork. Source: authors.

Entanglements

We returned to Salisbury Crags to better understand our own entanglements with the landscape by observing how other humans moved through it. An orienteering event provided a revealing opportunity. Roads were closed, traffic diverted, and access carefully managed; some paths became temporarily acceptable, while others remained protected. This made the site's politics of access difficult to ignore. If falling rocks justified fencing and exclusion in some places, why were unstable slopes and cliff edges acceptable elsewhere? Although the event included environmental precautions, such as dispersing competitors and clearing litter afterwards, these measures did not seem to address the wider ecologies described in site management documents (Historic Environment Scotland, 2019). Salisbury Crags therefore appeared not only as a place of leisure or heritage, but as a site where human and more-than-human claims are continually negotiated.

This political dimension is inseparable from the site's cultural status. With Hutton's international recognition, Salisbury Crags became tied to narratives of scientific importance and civic prestige (Historic Environment Scotland, 2019; 'James Hutton: A timeless legacy', 2022). Preservation efforts followed, but so too did the assumption that value lies in keeping the landscape stable and legible (Historic Environment Scotland, 2024b; 'Geoheritage conservation and environmental policies: retrospect and prospect', 2025). Yet landscapes are not static: they are ecologies with their own histories and rhythms (Massey, 2011; Wolkovich *et al.*, 2014). Preserving them is therefore not a matter of freezing them in place, but of negotiating between cultural value, ecological change, and more-than-human processes (Gordon, 2012).

This tension became clearer when we examined how the site is publicly framed. A 2023 survey conducted by Historic Environment Scotland showed that visitors prioritised present-day access, safety, and convenience (Historic Environment Scotland, 2024a). As shown in Figure 5, users were primarily motivated by exercise, scenic enjoyment, and everyday recreation, while Figure 6 shows that they prioritised practical concerns such as accessibility, safety, and path management. These concerns are understandable, but they also reveal how difficult it is for deeper ecological temporalities to enter public perception.

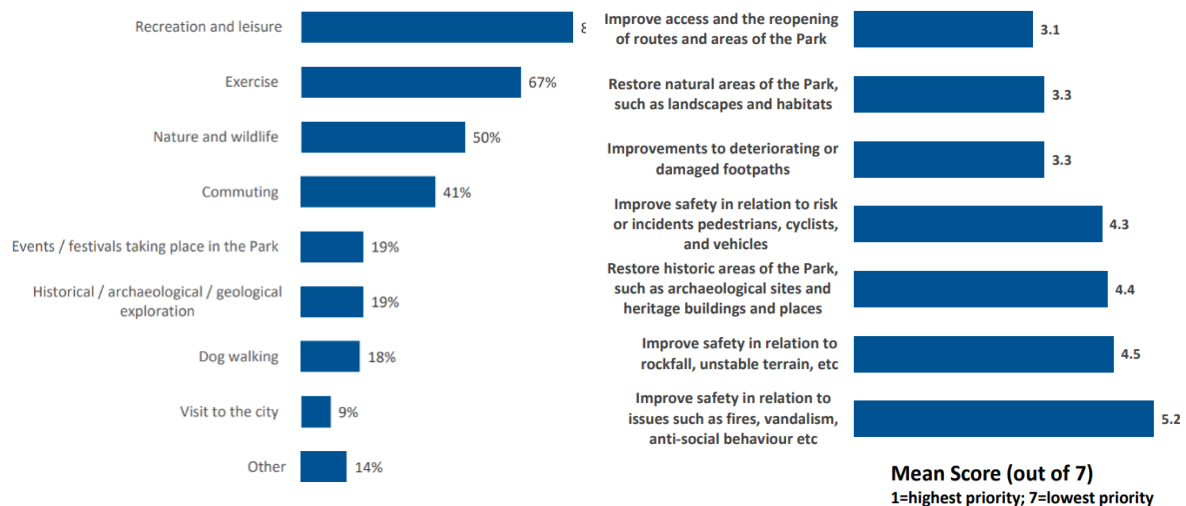


Figure 5. Main motivations for visiting Holyrood Park. Source: Historic Environment Scotland (2024a).

Figure 6. Aspects prioritised by respondents in relation to Holyrood Park. Source: Historic Environment Scotland (2024a).

Against these visible politics of access and preservation, we became increasingly aware of what remained absent. The microbial communities of the site predate not only the present park infrastructure, but even the rock, the moss, and the atmosphere itself. Yet across the significance, planning, and management documents we reviewed, these assemblages were not meaningfully acknowledged (Historic Environment Scotland, 2019, 2024a, 2024b). This helped shift our attention from surface appearance to what takes place below ground. Tsing's (2010) call to attend to what lies beneath therefore became newly resonant. From this point, our focus moved towards soil microbial communities and the ecological rhythms in which they participate, including decomposition, nutrient cycling, water retention, and pollutant breakdown (Shu and Huang, 2022). This shift crystallised the focus of *Look Down*: to look down was not only to look underground, but to encounter a different order of ecological significance (Macfarlane, 2020; Ecologies Group 2, 2026).

Ideation

If the previous section clarified why microbial life mattered to our reading of Salisbury Crag, ideation asked how those hidden underground relations might be translated into a public encounter. Rather than moving directly into form-making, we began by identifying which environmental rhythms and conditions had most strongly shaped our understanding of the site, and which of these could guide design decisions.

Two datasets became especially important. First, our comparative rainfall data showed that Edinburgh sits within a relatively moderate but persistent hydrological pattern, with monthly rainfall ranging from 46 mm to 73 mm. This contrasted with much wetter sites such as Dar es Salaam, which peaks at 255 mm in April, and much drier patterns such as Sacramento, where rainfall drops close to zero in summer (see Appendix A). Microbial communities are extremely sensitive to soil moisture: through their lens, rainfall is not simply weather, but a key temporal driver of activity.

Second, our comparison of soil-constitution data suggested that Edinburgh's soil conditions were part of a broader ecological spectrum rather than an extreme case. In the dataset we used, Edinburgh showed a pH of 5.8, a Nitrogen_count of 2.2g/kg, a Carbon_count of 2.216g/kg, and total

exchangeable bases of 15cmolc/kg. In the processed rankings where global soils were ranked using ten bins of equal size, it scored relatively highly for Nitrogen (rank 9/10) and Carbon (rank 8/10), but the acidic soil and low Carbon-Nitrogen ratio (rank 3/10) suggested Edinburgh soils are bacterially-dominated and likely leach nitrogen under heavy rainfall (FAO and IIASA, 2023; see Appendix B). Together, these comparisons established two design axes that remained central throughout ideation: rainfall as a temporal driver, and soil parameters as differentiated conditions through which microbial activity could be interpreted.

To explore how these variables might become legible within a design process, we developed two digital tools. A soil-parameter simulation built in d3.js, REACT and Next.js allowed us to compare variables and group parameters in a more accessible visual language (Figure 7). In parallel, a microbial community pendulum simulation developed in Python helped us test how temporal input might be embodied through oscillation and changing movement over time (see Appendix C). Together, these experiments helped us move from static values towards more relational forms of translation.

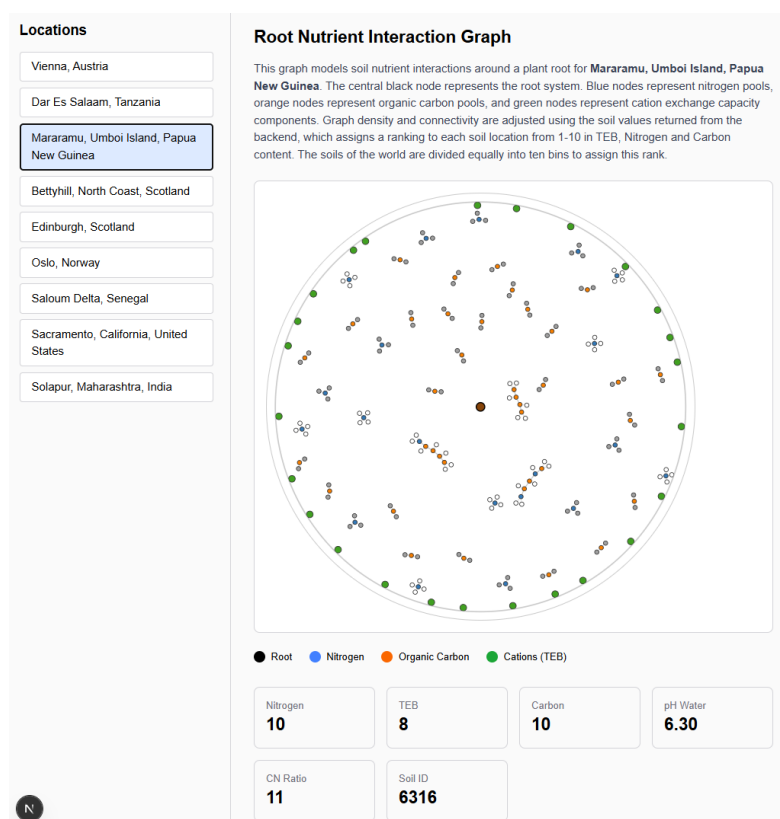


Figure 7. Soil parameter simulation developed in d3.js, REACT and Next.js, used during ideation to explore how selected soil variables might be grouped and translated into interaction. Source: authors, based on FAO and IIASA (2023).

One of the first major concepts to emerge from this work was a “layer cake” model of the underground system. Drawing on the stratified condition of soil, this proposal imagined the underground as a sectional structure in which different layers represented distinct ecological properties and processes (Figure 8). Although the idea captured the ambition of making hidden ecologies visible, feedback quickly revealed a central problem: it attempted to hold too many variables and meanings at once, making the concept difficult to read.

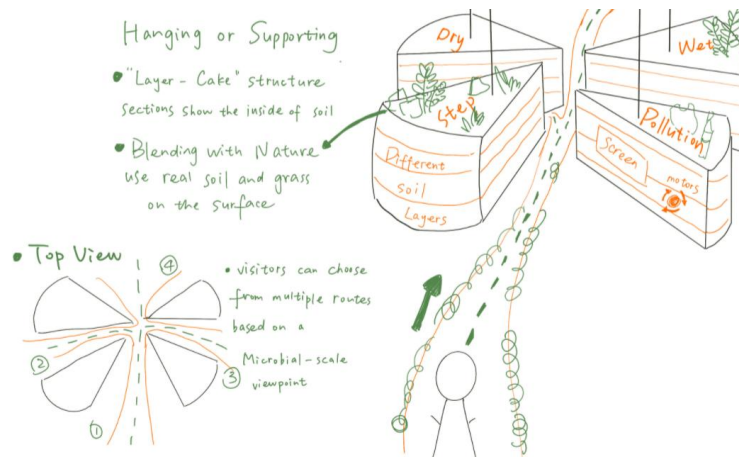


Figure 8. Early “layer cake” ideation sketch, attempting to represent the underground ecosystem as a complete layered structure. Source: authors.

This prompted a more focused design question: rather than trying to model the entire underground system, which relation or mechanism could best embody microbial activity? In response, the project shifted towards a system of suspended forms, or “hanging spheres” (Figure 9). Here, environmental factors such as rainfall, human disturbance, and material change were translated into motion, rhythm, and relation rather than static representation. This marked a significant conceptual transition: the project moved from visualising an ecological system to designing a mechanism through which hidden processes might be sensed.

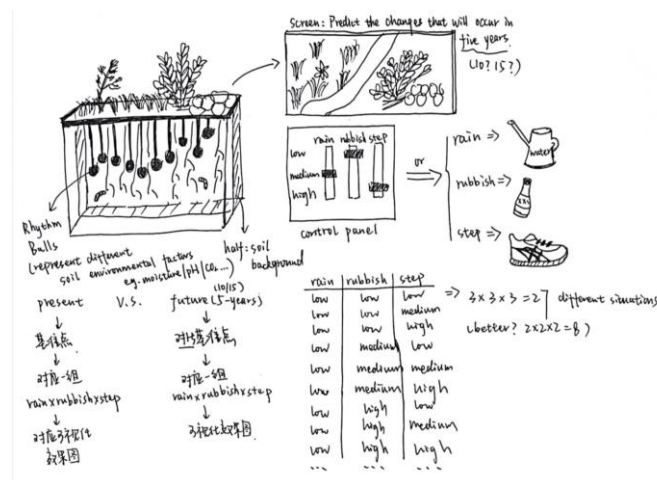


Figure 9. Iteration of the “hanging sphere” concept, in which suspended forms were used to explore how environmental variables might be translated through motion. Source: authors.

Across subsequent iterations, we tested other possible directions, including a scale-based balancing system, a vertical hanging-board structure, and a projection-led approach to ecological temporality. These routes are documented in Appendices D–F. While valuable as speculative explorations, they also clarified an important limitation: when too many moving or symbolic elements were introduced, the work became harder to interpret.

This realisation led us towards the single pendulum structure that would define the next stage of the project. Compared to multi-element systems, the pendulum offered a more stable and sensitive mechanism through which motion could remain readable while still responding to external forces. In this way, ideation moved from broad ecological representation towards a more selective, data-informed translation of microbial life through movement, materiality, and interaction.

Development and prototyping

Building on the ideation phase, which narrowed the project from broad ecological representation towards a more selective translation of microbial activity, this stage focused on making that translation physically and technically viable. Rather than modelling the underground ecosystem in full, development concentrated on a mechanism through which environmental conditions could influence motion, material traces, and audience interpretation. The magnetic pendulum emerged as the clearest candidate for this role.

The core concept was to use a pendulum whose bob contained a permanent magnet to represent microbial life, with changes in its motion driven by magnetic forces exerted by nearby magnets. In this way, microbial activity was translated into oscillation, attraction, deflection, and instability rather than illustrated directly. A microbial community pendulum simulation developed in Python supported this process by helping us explore how temporal inputs might affect oscillation and response over time (see Appendix C).

Our first physical prototype consisted of a simple pendulum suspended above a plate containing fixed magnets (Figure 10). Here, the aim was to understand how the arrangement and polarity of the magnets influenced the pendulum's movement. These tests established the basic interaction logic and showed how small spatial adjustments could alter the range and rhythm of oscillation.



Figure 10. First prototype of the magnetic pendulum, used to test how different magnet arrangements influenced the pendulum's motion. Source: authors.

At the same time, we explored ways of making these otherwise invisible interactions visible. Possibilities included iron filings, ferrofluid, and leaking ink. Iron filings were ultimately selected because they were accessible, stable to store, and capable of producing clear visual effects without excessive technical complexity. As the pendulum passed above the plate, filings could be redistributed around magnetic zones, creating a material trace of unseen forces (Figure 11). This became important not only aesthetically, but conceptually, as the installation began to express microbial–environmental interaction through both motion and residue.



Figure 11. Early prototype with iron filings, showing how magnetic interaction could leave visible traces on the plate. Source: authors.

A major technical challenge was how to keep the pendulum in motion without making the actuation mechanism visually dominant. We explored several possibilities, including string pulling, parametric resonance, and electromagnets, but each introduced limitations in reliability, complexity, or legibility. We ultimately chose a hidden rotating permanent magnet positioned near the pendulum. This solution was both workable and conceptually resonant. Like rainfall in the ecological system we were studying, the rotating magnet acted as an external condition capable of increasing or reducing microbial activity. After designing and 3D-printing a motor stand and magnet holder, we connected the Arduino-controlled mechanism to annual rainfall data from Edinburgh, allowing the pendulum's motion to remain variable but structured by a temporal cycle (see Appendix A; Figure 12).

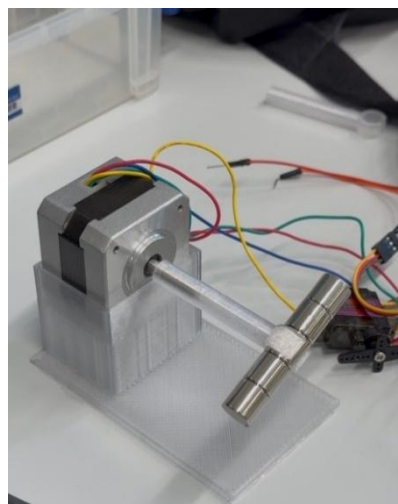


Figure 12. 3D-printed motor stand and rotating magnet holder used to connect pendulum motion to rainfall-driven actuation. Source: authors.

As the mechanism became more resolved, it also became clear that the support structure beneath the plate needed to do more than hold the hardware. It had to situate the mechanism within the project's wider underground narrative. Early ideas for the base included a more abstract contour-like structure, but because other parts of the installation were already operating through abstraction, we decided that the support structure should be more legible and grounded. This led to the development of the soil box as a representational cross-section of the underground.

The soil box was designed not simply as a base, but as a spatial and narrative device. Constructed from transparent acrylic, it allowed the underground to be seen rather than imagined. A lightweight internal cardboard support reduced overall weight while stabilising the magnetic plate above. Around this core, visible layers were assembled from soil, stones, moss, leaves, branches, and other collected materials, while plaster and painted elements were used to translate less visible subterranean forms such as roots, strata, and terrain changes. The final composition created the impression that the ground had been cut open and displaced, exposing layered conditions beneath the surface (Figure 13). Once the plate was installed within it, the soil box helped transform the mechanism from an isolated technical device into part of a coherent ecological scene (Figure 14).

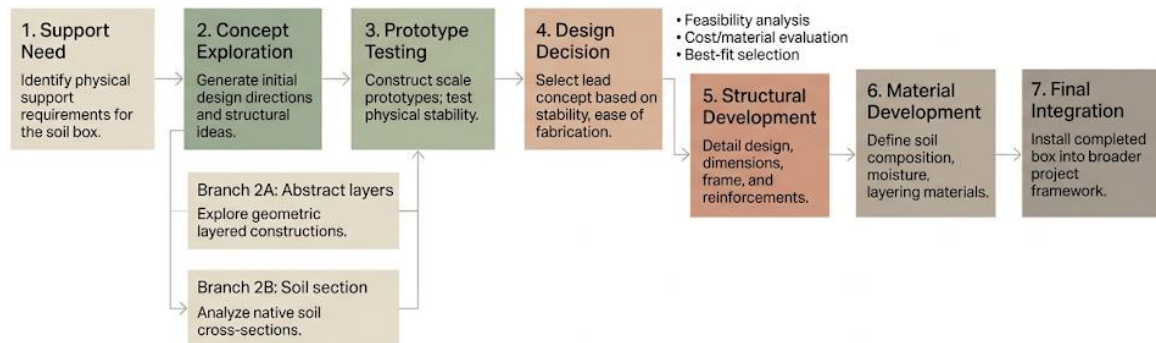


Figure 13. Flowchart showing how the soil box developed from an initial support requirement into a layered underground section integrated into the final installation. Source: authors.



Figure 14. Final soil box with the magnetic plate integrated into the layered underground structure. Source: authors.

In parallel, we refined the magnetic plate and the accompanying science-communication interface. The circular interface and the plate were both divided by root-like lines into multiple regions, while the magnets embedded beneath the plate were carefully aligned to influence filing patterns. Within the interface, these magnetic zones were represented as molecules and ions, helping to communicate processes of absorption, breakdown, and nutrient interaction. The interface therefore functioned as a complementary interpretive layer through which selected soil parameters — including nitrogen, carbon, pH, and TEB — could be made more legible to the audience (FAO and IIASA, 2023; see Appendix B; Figure 15).

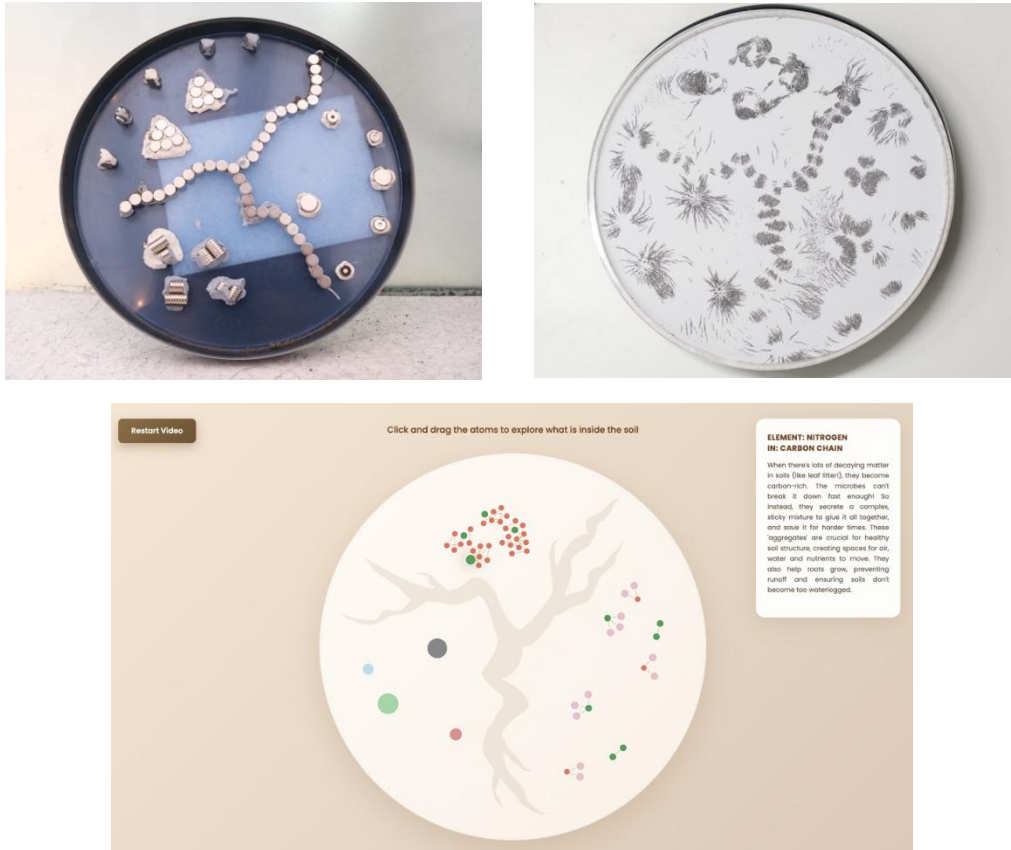


Figure 15. Final interface and magnetic plate arrangement, showing how soil parameters were translated into a science-communication layer. Source: authors; based on FAO and IIASA (2023).

Taken together, these stages of development transformed the project from an exploratory concept into a coherent installation comprising a pendulum, a magnetic plate, a soil box, and a science-communication interface. The final arrangement brought together movement, material layering, and digital interpretation to make underground microbial ecologies perceptible within an exhibition context (Figure 16).



Figure 16. Final installation combining pendulum, magnetic plate, soil box, and interface in the exhibition setting. Source: authors.

Reflections

Looking back across the process, one of the most important lessons of this project was the need to move from breadth to focus. Our early ideas tried to hold too much of the underground ecosystem at once, with multiple soil factors, temporalities, and human impacts competing within a single installation. Through feedback, prototyping, and repeated returns to our field observations, we came to understand that the project became stronger when it stopped trying to represent the whole system and instead concentrated on a more specific translation of microbial activity. This shift clarified the role of pendulum motion, magnetic interaction, layered soil materiality, and interface design within a more legible experiential logic.

The exhibition further sharpened this understanding by revealing both the strengths and the limitations of the final work. The soil box and exposed underground section helped ground the concept visually, giving audiences a clearer connection to subterranean ecology than a more abstract structure would have allowed. At the same time, much of the engagement remained observational rather than strongly participatory. Both the magnetic plate and the digital interface asked viewers to look, interpret, and understand, which could become cognitively demanding. Public feedback also confirmed that guidance matters: in an exhibition setting, audiences need to understand quickly what the work is doing and how they are invited to engage with it. We therefore see the final installation not as a finished answer, but as a situated translation that clarified its own next step — strengthening the relationship between digital input, physical response, and audience participation.

Conclusion

This project began with Salisbury Crags as a site of deep time, visible geology, and contested human–more-than-human relations, but gradually shifted attention towards what remained hidden beneath the surface: soil microbial life and the ecological processes it sustains. Rather than attempting to represent the underground in its full complexity, *Look Down* developed as a selective translation of microbial activity through pendulum motion, magnetic interaction, layered materiality, and an interpretive interface. In doing so, the project reframed data not simply as something to visualise, but as something to interpret spatially, materially, and temporally within an installation context.

The final installation therefore matters not only as a design outcome, but as a critical reorientation of attention. By asking audiences to “look down,” the project challenged surface-level and human-centred ways of encountering the site, foregrounding microbes as active participants in hydrological regulation, nutrient cycling, decomposition, and wider ecological maintenance. In this sense, the work aligns with the idea that ecologies unfold across both spatial and temporal axes (Wolkovich *et al.*, 2014), and that microbial life, though often invisible, acts as a steward of planetary processes (Helmreich, 2023).

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AI statement

We used generative AI in a limited and clearly bounded way during the early ideation and development stages of this project. ChatGPT (OpenAI, GPT-5.4, accessed Feb 2026) supported us in drafting early simulation scripts, allowing us to test and iterate ideas related to soil parameters, pendulum motion, and possible microbial–environment interactions more rapidly. We also used generative AI selectively to produce exploratory concept images and visual references during the development of the installation, including early underground-section and soil-box directions. We treated these outputs as provisional stimuli for discussion rather than as final design solutions.

We developed, reviewed, and refined all final design decisions, data analysis, interaction logic, prototyping, fabrication, and visual selection as a team. For the writing of this report, we used AI only for grammar checking. All arguments, structure, analysis, and critical reflections were developed by us.

Appendices

Appendix A

Full comparative rainfall table used to position Edinburgh within a broader range of hydrological conditions. Referenced in main text in the Ideation section.

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vienna	31	32	35	43	62	72	68	61	42	37	46	36
Dar es Salaam	75	55	140	255	200	45	25	25	25	70	125	120
Mararamu	487	392	511	466	374	308	264	342	389	534	478	482
Bettyhill	21	25	19	13	22	18	24	27	19	32	24	21
Edinburgh	66	47	57	46	57	56	62	70	71	73	69	63
Oslo	53	41	51	45	56	69	83	91	94	92	80	60
Saloum Delta	1	1	5	2	1	11	40	192	161	28	1	9
Sacramento	22	20	26	7	12	0	3	0	1	3	10	18
Solapur	3	3	6	11	20	247	241	230	233	142	17	2

Appendix A. Monthly rainfall data compiled across selected global locations.

Appendix B

Full table of soil variables and processed rankings used during comparative analysis.

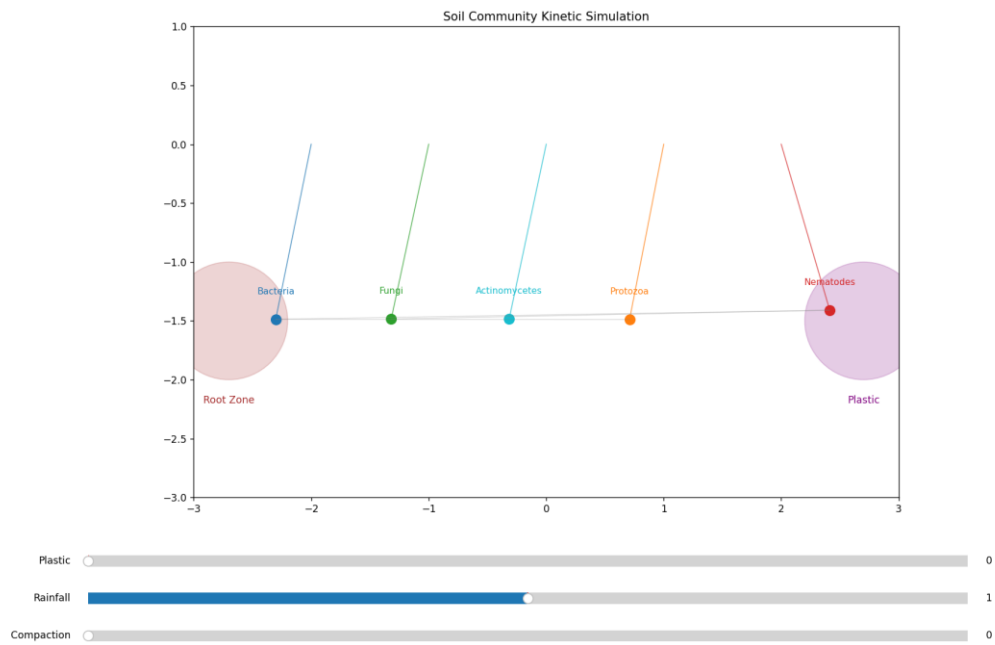
Data extracted from Food and Agriculture Organization of the United Nations (FAO) and International Institute for Applied Systems Analysis (IIASA) (2023).

Variable	Vienna	Dar Es Salaam	Mararamu	Bettyhill	Edinburgh	Oslo	Saloum Delta	Sacramento	Solapur
Id	9993	27257	6316	10830	10815	10124	31728	4765	3861
Raw	N_count	3	2	5	15	2	4	1	2
	Cec_count	26	6	33	37	18	10	40	18
	C_count	3	2	5	37	2	7	1	2
	Ph_water	7	5	6	4	6	5	8	7
	Cn_ratio	12	12	11	23	11	18	10	12
	Bsat	93	28	77	54	61	27	100	87
	Bulk	1	1	1	0	1	1	1	2
	Teb	26	5	32	41	15	7	40	17
Processed	N_rank	9	8	10	10	9	10	2	5
	Cec_rank	7	2	8	9	5	3	10	5
	C_rank	9	8	10	10	8	10	3	4
	Ph_rank	5	1	5	1	3	1	10	7
	Cn_rank	4	4	3	7	3	7	2	2
	Bsat_rank	7	1	4	2	3	1	9	6
	Bulk_rank	3	3	1	1	4	2	5	6
	Teb_rank	7	2	8	10	5	2	10	6

Appendix B. Raw and processed soil-constitution data across selected global locations.

Appendix C

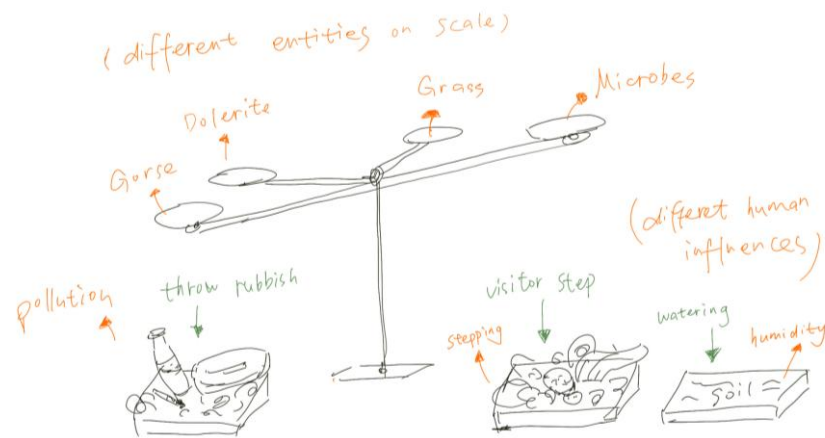
Additional screenshots and notes from the Python simulation used to explore how key parameters might affect microbial interaction over time.



Appendix C. Microbial community pendulum simulation developed in Python.

Appendix D

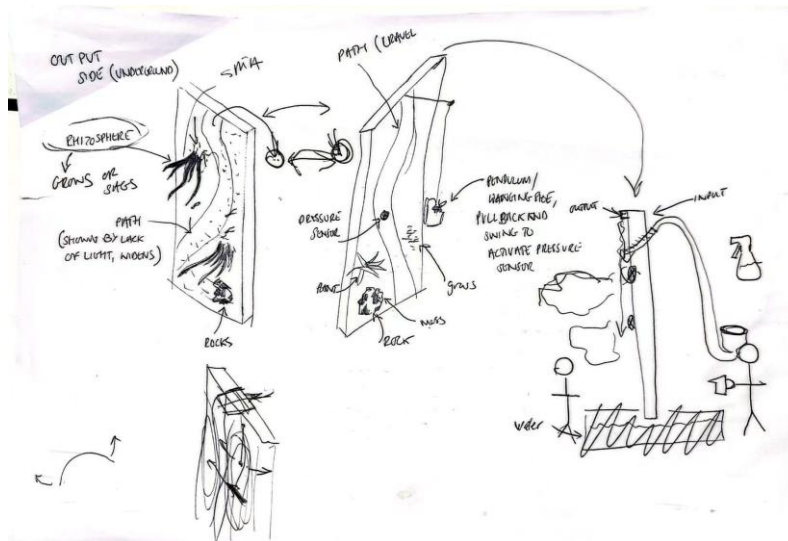
An early concept using scales to simulate how soil elements might influence one another.



Appendix D. Alternative ideation concept: scale-based system.

Appendix E

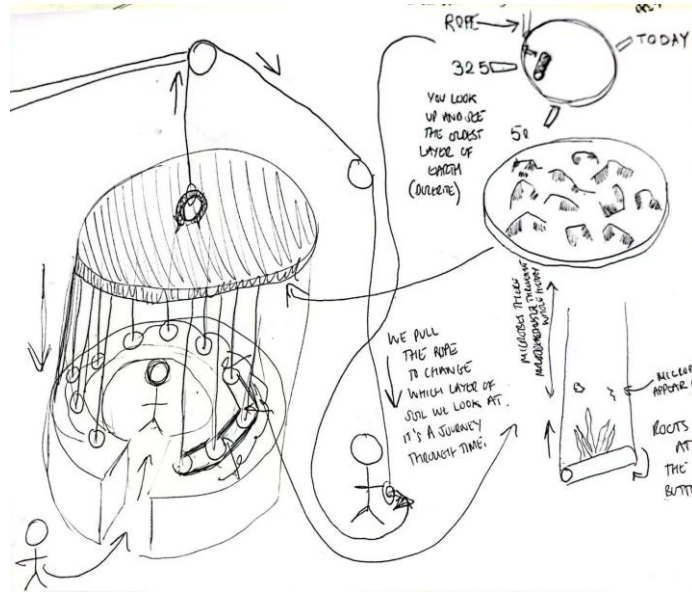
An iteration of the hanging-sphere concept transforming the board into a vertical structure and contrasting above- and below-ground relations.



Appendix E. Alternative ideation concept: vertical hanging-board iteration.

Appendix F

An ideation route using projection to represent ecological temporality and environmental change.



Appendix F. Alternative ideation concept: projection-led temporality.