

LOOK DOWN

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By integrating hydrological and microbial data, LOOK DOWN shifts our focus from grand human narratives to the invisible microscopic world in our soil. The project reveals the overlooked power of microorganisms in environmental remediation. It explores how, by listening to the Earth's "smallest breaths," we might rebuild a symbiotic relationship with our ecosystem.



Overall Display



Close-up of key elements

Tactile yarn forms embody microbial life. They respond to the influx of rainfall and actively drive the subterranean flow of nutrients.



 Microbe



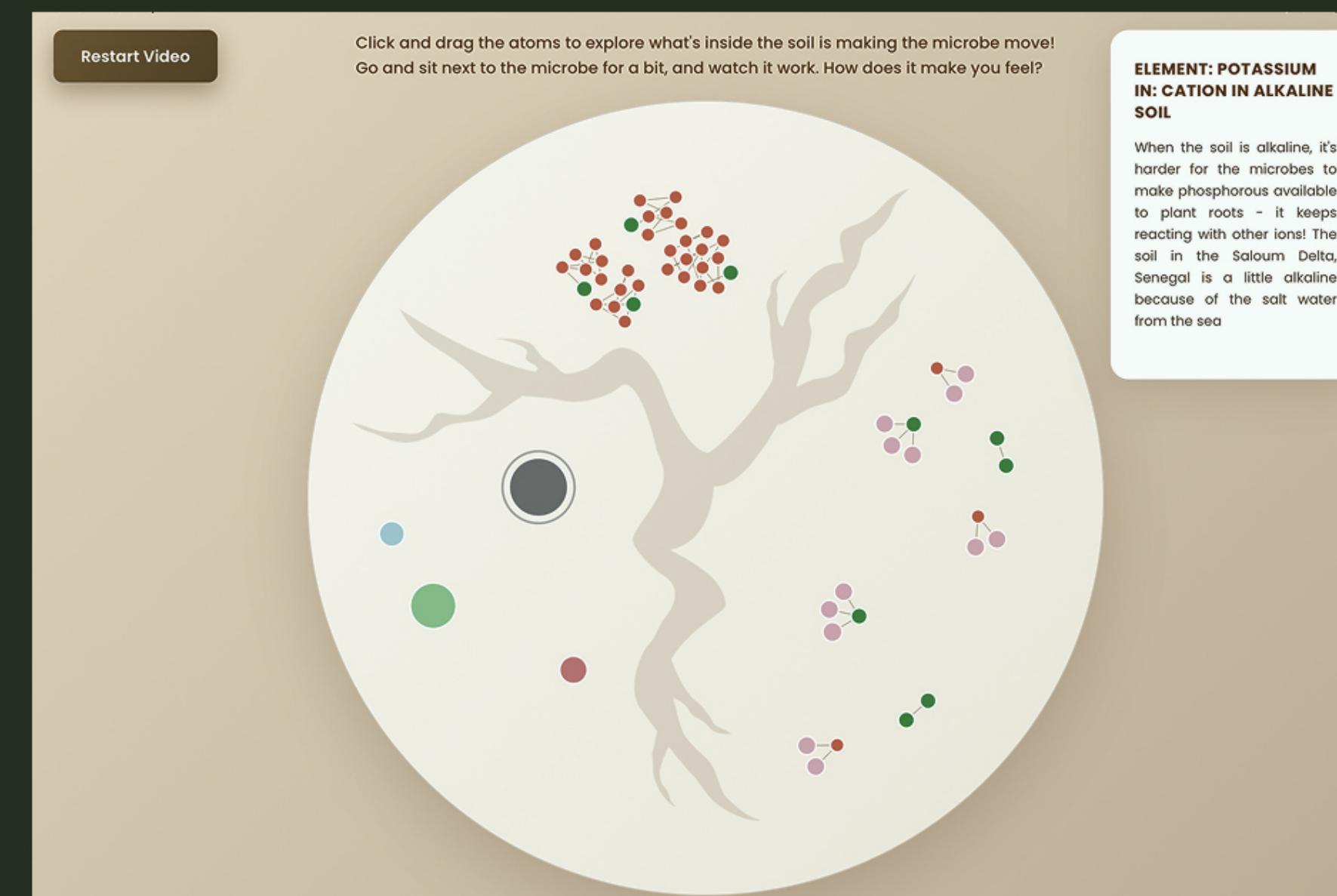
 Plate

Magnetic powder patterns visualize the spatial distribution of three essential nutrients within the soil.

Exposes the layered structure beneath the ground, guiding the audience's perspective below the surface.



 Soil Box



 User Interface

Acting as a digital counterpart to the Plate, the interface layers unpack the installation's conceptual depth.



The spellbinding dance of the microbe,
perpetually working and impossibly
suspended by a singular string, forms
the heart of the installation.

As it draws visitors closer, they
observe a delicately designed
physicalisation of the interactions
between the microbial communities of
Edinburgh soils, their underground
environments and seasonal rainfalls.

This work is necessarily speculative: often referred to as a
‘black box’, soil makes direct observation of these
microbial communities in their natural habitat impossible.

“So... How does it work?!”

Visitor, Anonymous

Plate Design

What we can (and frequently do) observe are snapshots: of the the chemical composition of a soil and its metagenomic makeup. From such studies, we continue to discover incredible diversity in soils and in the resilient, responsive communities of microbes that inhabit them. On different temporal scales, microbial communities both dynamically respond to and construct their local environments.

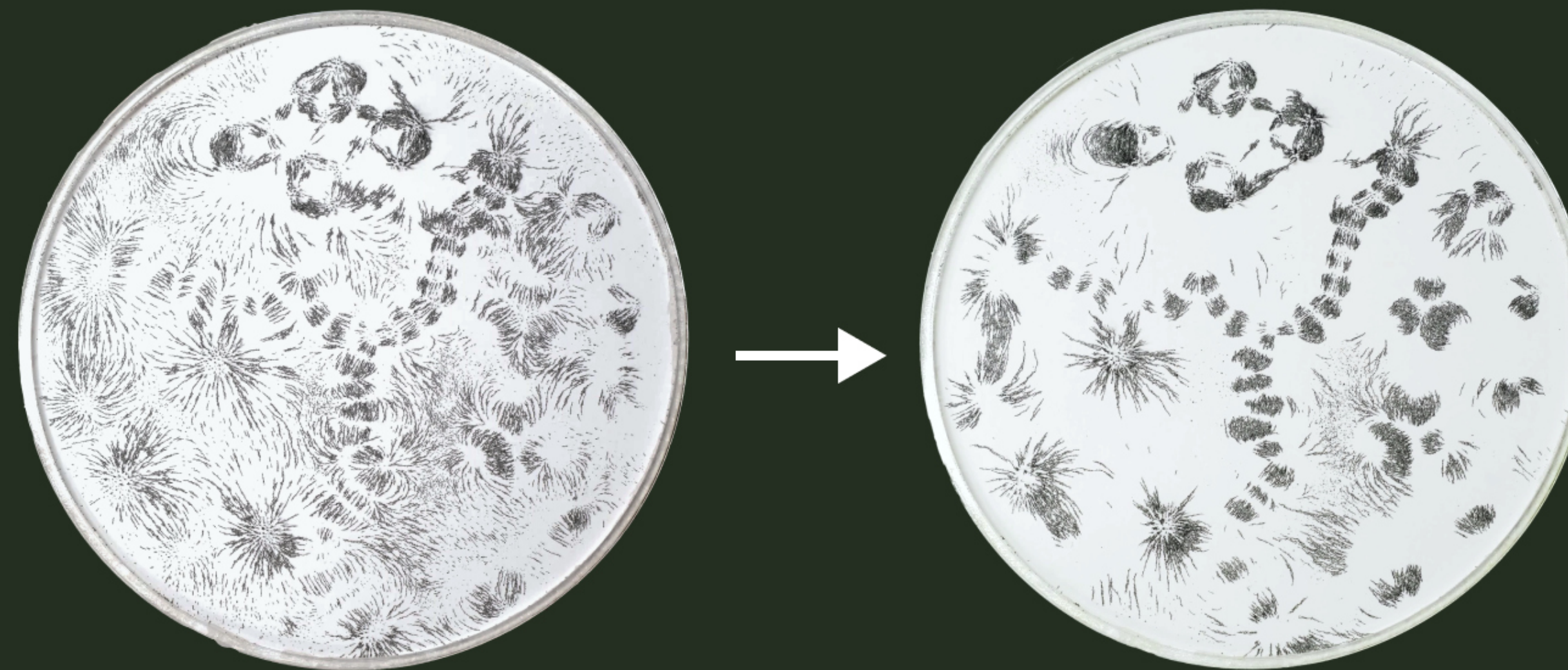
Their response to different soil conditions is represented by the motion of the suspended 'microbe', which hides **a permanent magnet**.

This magnet is guided along a network of magnetic field lines generated by further magnets, carefully arranged underneath the 'plate' to represent chemical constituents of Edinburgh soils, each with a custom configuration.

Read the callout for an example of how these guide the 'dance' of the microbe.



The magnetic field created by this 'Nitrate' imparts rotational acceleration on the microbial magnet, representing the energy obtained from their decomposition of organic chains into this important ion.



Over billions of annual cycles, microbes have built the dynamic, balanced ecosystems in today's soils. The slow coalescence of the installation's iron filings represent this process. Bit by bit, they are encouraged by the magnetic pull of the dancing microbial magnet into a stable, yet still dynamic picture over the course of the entire installation.

What?

Cation in acidic soil

Magnet Configuration

Strong, oriented to attract the suspended microbe.

Motion initiated

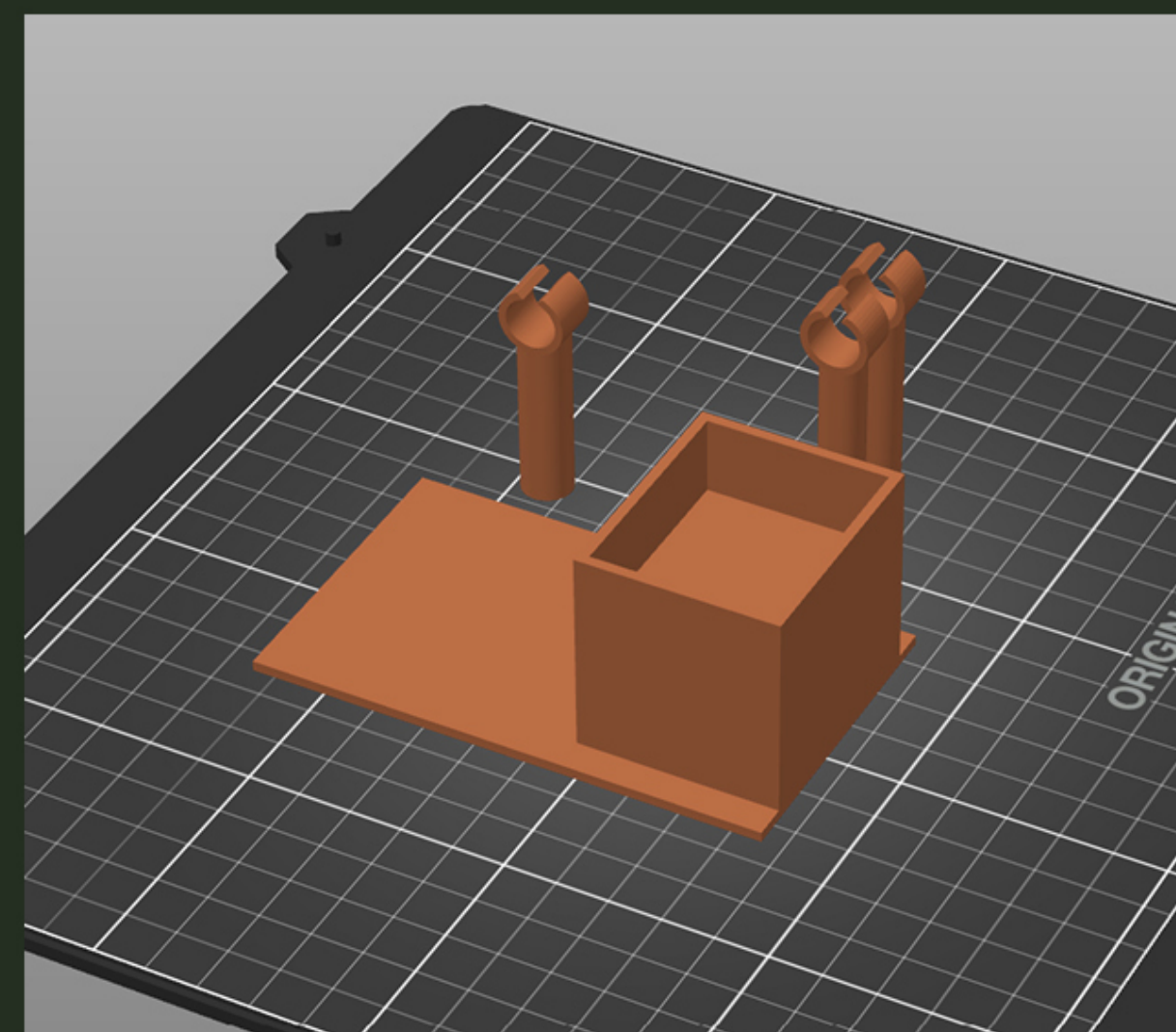
Damps Microbe spin and even stops it for a moment.

Why?

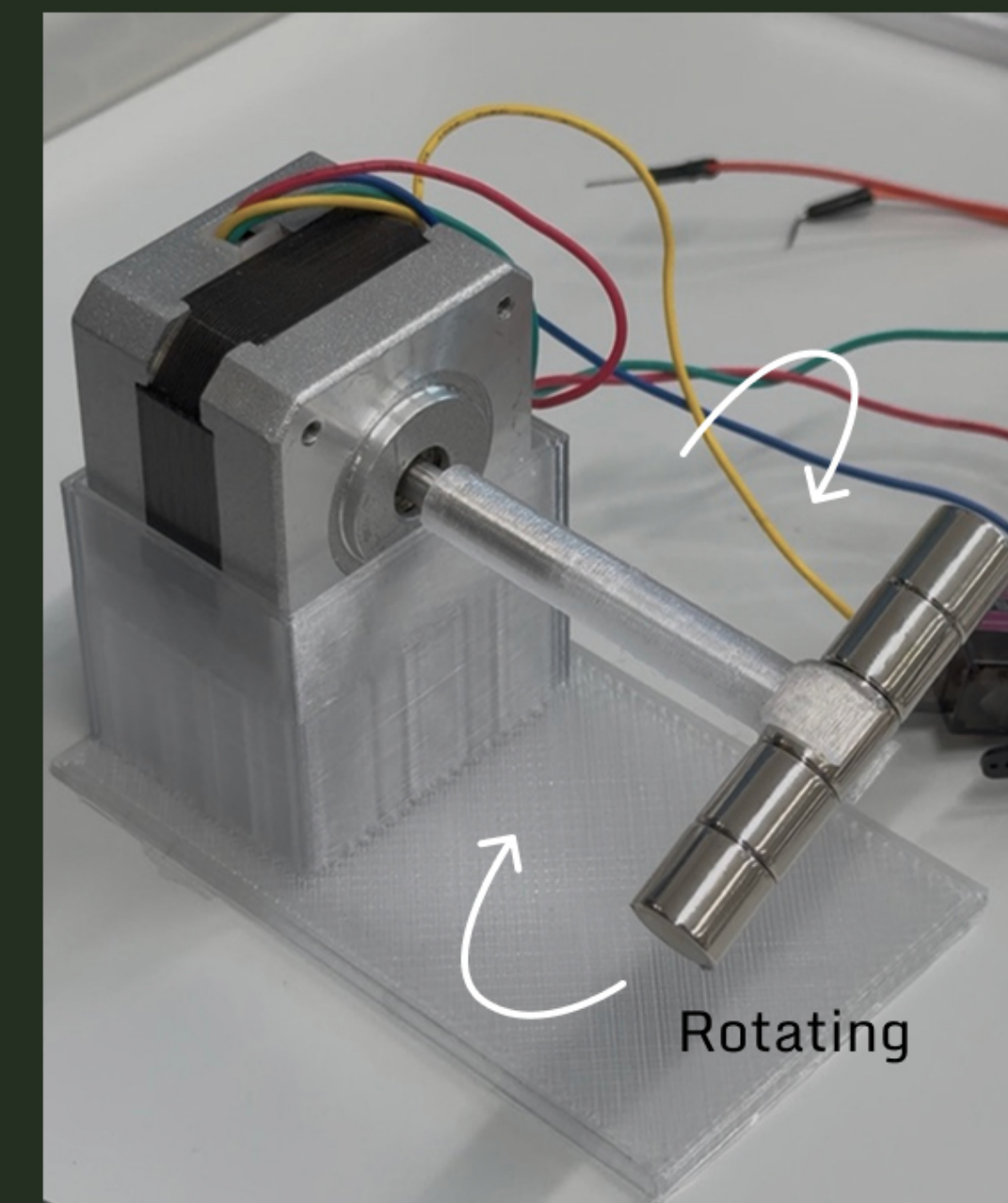
Acidic cations are difficult for microbes to cycle and can even poison them.

Rainfall System

Water, as the most basic nutrient on the earth, also changes the activities of the microbes. In the nature, microbes react to the rain as it change the humidity in the soil. However, both the water is too much or too little reduce the activity of microbes. The microbes are the most energetic only if the water is appropriate. We wanted our installation to show this as well.



We 3D printed the holder and a stand for the motor, hid the entire actuator in a stone near the pendulum, magically indicates the power of water in the soil.



```
void loop() {
    float T = 2.0 * PI * sqrt(PENDULUM_L / G);
    float resDelayUs = resonantStepDelayUs(T);

    for (int month = 0; month < 12; month++) {
        int stepDelay = rainfallToStepDelay(rainfall[month], resDelayUs);
        float motorPeriod = (float)stepDelay * STEPS_PER_REV / 1e6;
        float motorRPM = 60.0 / motorPeriod;
        float detuning = (motorPeriod - T) / T * 100.0;

        Serial.println("-----");
        Serial.print("("); Serial.print(monthNames[month]); Serial.print(") ");
        Serial.print(rainfall[month], 0); Serial.print(" mm | ");
        Serial.print(motorRPM, 2); Serial.print(" RPM | ");
        Serial.print("T_motor="); Serial.print(motorPeriod, 3); Serial.print("s | ");
        if (abs(detuning) < 3.0) {
            Serial.println(">>> NEAR RESONANCE <<<");
        } else if (detuning < 0) {
            Serial.print("too fast ("); Serial.print(detuning, 1); Serial.println("%)");
        } else {
            Serial.print("too slow (+"); Serial.print(detuning, 1); Serial.println("%)");
        }

        // Drive magnet motor continuously for DRIVE_MS at this month's speed
        unsigned long t0 = millis();
        while ((millis() - t0) < DRIVE_MS) {
            singleStep();
            delayMicroseconds(stepDelay);
        }

        releaseCoils(); // De-energize coils between months (reduce heat)
        delay(MONTH_PAUSE_MS); // Brief pause before next month
    }

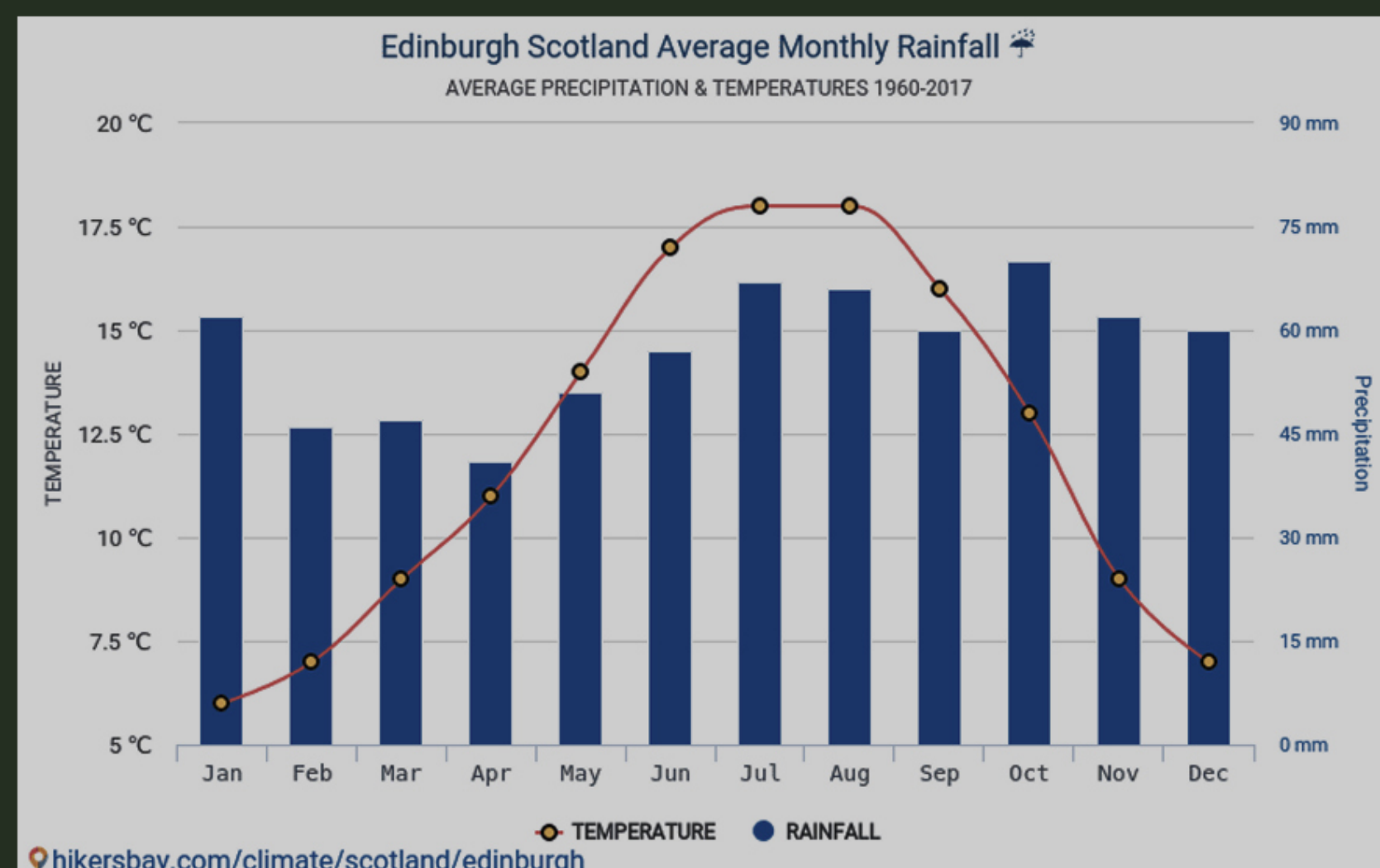
    Serial.println("\n=== 12-month cycle complete. Restarting... ===\n");
    delay(CYCLE_PAUSE_MS);
}
```

The movement of the pendulum is the most only if the period of rotating is equal to what of the pendulum, neither the magnet rotated too fast or too slow. Exactly as the water to the microbes. Although the movement is still slightly random, but the range of motion is fixed within a cycle.

Conclusion

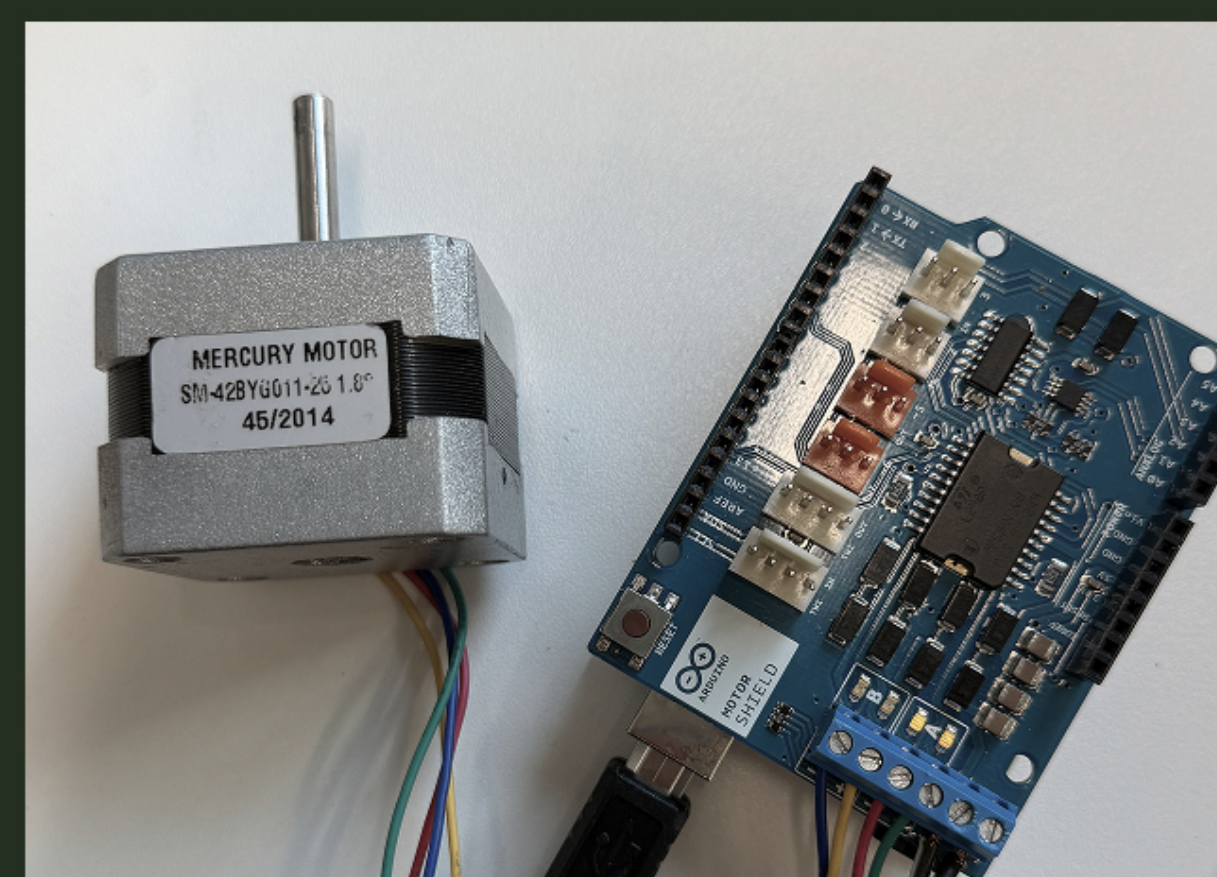
Hence, microbe movement is guided by magnetic fields designed using rainfall and soil chemistry data. However, due to the unpredictable external influences such as the touch of visitors, small movements of the suspension pole and air flows, its motion remains chaotic: two dances are never be the same.

By exploiting how sensitively magnetic forces respond to separation distance, the installation offers an organic illustration of the vast diversity in microbial activity. Our global database review and soil-sample analyses revealed that—much like humans who co-evolved with microbial communities—no two soils are ever truly alike.



```
// — Edinburgh monthly rainfall (mm), Jan-Dec (from rainfall.csv) —
const float rainfall[12] = {66.0,47.0,57.0,46.0,57.0,56.0,62.0,70.0,71.0,73.0,69.0,63.0};
const char* monthNames[12] = {
    "Jan","Feb","Mar","Apr","May","Jun",
    "Jul","Aug","Sep","Oct","Nov","Dec"
};
```

Edinburgh's annual rainfall data of is collected and connected to a motor holding a permanent magnet on its end, influencing the activity of the microbe.



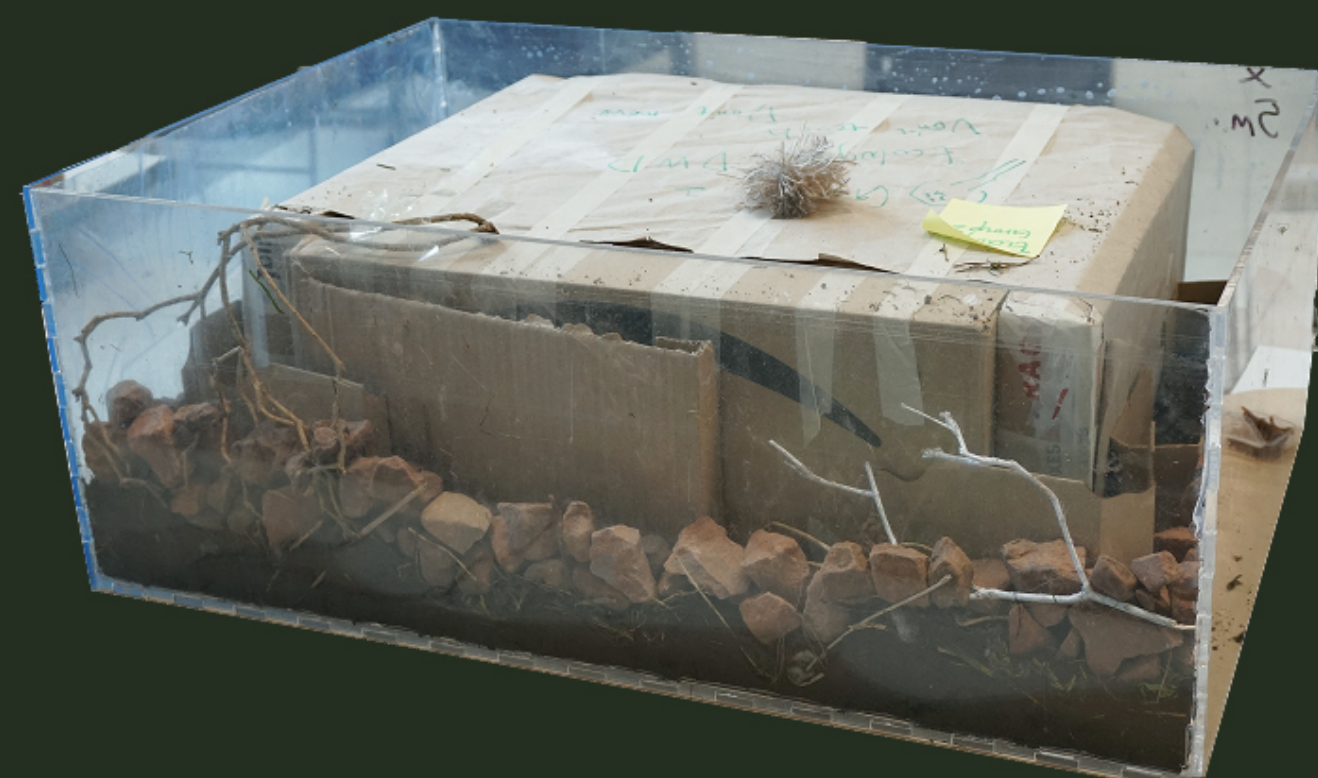
Soil Box Design

The soil box was developed not simply as a support for the magnetic plate, but as a spatial device that could make the underground world of LOOK DOWN more legible.

By revealing soil layers, roots, stones, and displaced surface matter, it helped connect the abstract motion of the pendulum and plate to a more recognisable ecological environment.

Structure & Material

The final structure combined a transparent acrylic box with an inner lightweight cardboard support to reduce weight while stabilising the plate above. Real materials such as soil, stones, weeds, leaves, moss, and branches were layered around this internal core, while plaster and painted elements were used to translate less visible subterranean forms such as roots and terrain shifts.



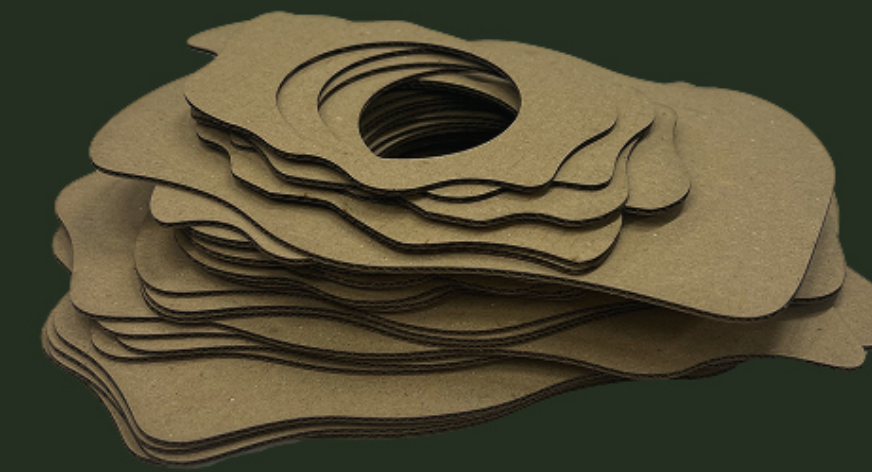
Internal support structure



Material study

Concept Shift

Early design development explored two directions: an abstract representation of underground space using layered contour-like surfaces, and a more representational soil cross-section using visible strata and real materials.



① Abstract prototype



② Section prototype

The latter was ultimately chosen because it grounded the installation more clearly, balancing the already abstract metaphorical language of the bob and magnetic traces.

Final Integration

The soil box ultimately became more than a base. Its sectional composition and piled upper surface created the impression that the ground had been opened and displaced, exposing the hidden world below. Integrated with the plate and pendulum, it transformed the supporting structure into a coherent ecological frame for the final installation.



Plate in the soil



Installed with pendulum



Final soil box

User Interface Design

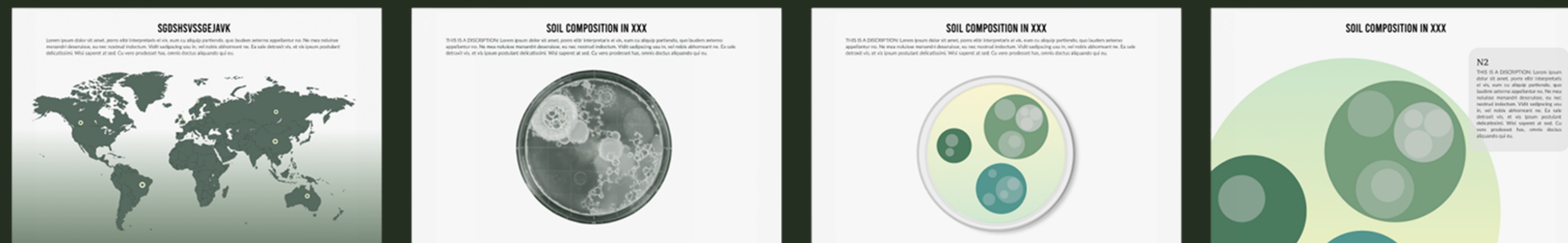
Project Goal

From Abstract Visuals to Scientific Insights

The installation visualize the invisible work of soil microorganisms. However, the physical phenomenon is too abstract for the general public. We need an extra explanation — user interface acts as a "Visual Translator," bridging the gap between artistic abstraction and scientific understanding.

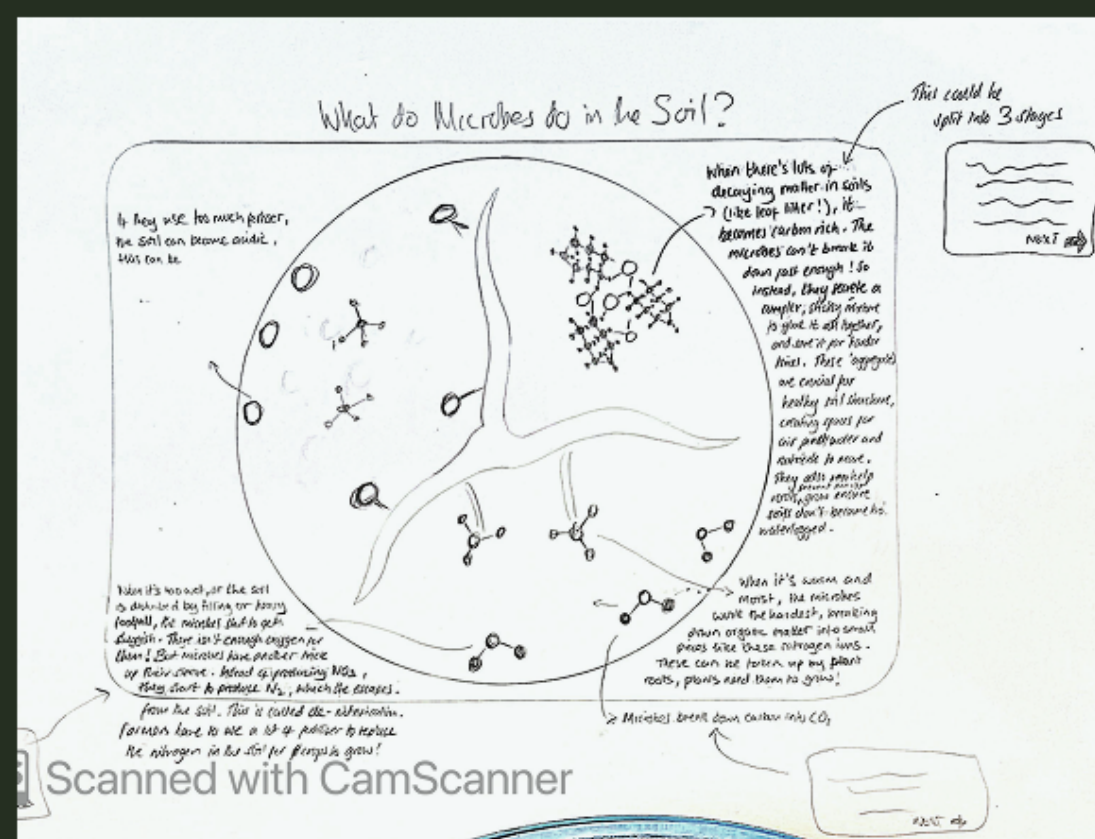
Iterative Evolution

Phase 1 : Low-Fi



Low-fi prototype: Establishing a macro-to-micro connection. Starting from a global map and zooming into a circular interface that mirrors the installation.

Phase 2 : Mid-Fi



Sketch of the mid-fi: Refining the visual language to align with the distribution of the organic textures formed by the magnetic powder.

Phase 3 : Hi-Fi



Final user interface: Cinematography of iron-powder redistribution lets audiences interactively explore how microbes reshape soil at atomic level.

Feedback from Audience



Observation 1: Disconnect

“Because the screen was so far from the installation, I didn’t realise how it connected to the physical installation.”

Observation 2: Unclear Guidance

I barely noticed the ‘Replay’ button in the top-left corner, so many of us missed the main narrative video entirely.”



Observation 3: Illusion of Real-Time Control

The drag atoms were fun to play with, but they made me think I was controlling the pendulum in real time. It felt interactive, but we didn’t fully understand how the system really worked.

Future Improvement

① Refine the user flow

Set the "redistribution video" as the auto-resetting homepage to ensure every visitor starts with a complete story.

② Clarifying the Interaction Metaphor

Refine visual cues to distinguish "educational simulation" from "real-time control," making the symbolism self-explanatory.

③ Strengthen Spatial Synergy

Reposition hardware to create a direct line-of-sight and intuitive link between the UI and the physical installation.

LOOK DOWN ultimately developed into an installation that reorients attention toward the hidden ecological life beneath the surface. By combining movement, layered materiality, and digital interpretation, the project sought to make soil microbes perceptible not only as scientific matter, but as active agents within a wider underground environment.

In this sense, the final work was not simply about explanation, but about shifting perception: inviting audiences to look down and reconsider what usually remains unseen.

Grounding the Concept

The exhibition confirmed that the project's material language was crucial in making the concept legible. In particular, the soil box and exposed underground section helped audiences connect the installation to subterranean ecology more quickly than a purely abstract structure would have. Their layered composition provided a recognisable ecological frame that supported the project's central concern with hidden microbial life.



Public Encounter

At the same time, public feedback revealed that much of the engagement remained observational rather than participatory. Both the magnetic plate and the iPad interface asked viewers to look, interpret, and understand, which could become cognitively demanding over time.

The exhibition also reinforced the importance of clearer guidance:

in a public setting, audiences need to understand within seconds what the work is doing and how they are invited to engage with it.

Reflection and Future Development

These observations do not weaken the project's critical position, but sharpen it. LOOK DOWN successfully foregrounded overlooked underground ecologies and challenged surface-level, human-centred ways of seeing environmental systems.

However, the exhibition also clarified the next developmental direction: strengthening the relationship between digital input and physical response, reducing interpretive friction, and making participation more immediate.

A future iteration could allow the interface to directly affect the behaviour of the installation, creating a stronger connection between audience action, environmental conditions, and microbial movement.

LOOK DOWN

The final installation made underground ecologies visible.
The exhibition made its future direction legible.