Neurodiversity-Inclusive Co-Designing for Biodiversity:
A Framework for Equitable Interventions

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Introduction

This report addresses the need for more effective and equitable biodiversity interventions, particularly for underrepresented groups. Making interventions more equitable means that everyone, regardless of background or ability, can participate and benefit from environmental initiatives. However, many biodiversity projects fall short in accessibility and inclusivity, inadvertently excluding those with physical disabilities, sensory processing differences, or from low-income backgrounds. This is not intended to be a direct critique of the work of the University of Edinburgh but rather to point out something that is common in the work of many organisations. This report will highlight problems with some typical approaches and propose a co-design framework, with a sensory garden as a case study, as a solution to these challenges.

The co-design framework is built on the principles of participatory decision-making and adaptive design, ensuring that biodiversity projects are shaped by both ecological expertise and the needs of diverse community members. This framework consists of four phases: outreach and recruitment, co-designing workshops, finalising the design, and implementation and stewardship. The report will apply this framework to a sensory garden, which serves as a case study to illustrate the practical application of inclusive design.

By implementing this co-design framework, we argue that biodiversity interventions can become more equitable and effective. The framework not only addresses physical and sensory barriers but also combats social injustice by focusing on marginalised groups. Moreover, by involving people in the design process, we can help communities feel more integrated with the environment, leading to a stronger sense of responsibility.

Context

The development of our biodiversity intervention framework came from a critical reassessment of early ideas that prioritised physical outputs over inclusive processes. Our initial proposal, the Pentland Hill Trail, aimed to create a scenic outdoor space for community engagement. While appealing in concept, this idea faced significant limitations:

1. *Practical Challenges*: The trail's remote location raised concerns about accessibility and long-term maintenance, particularly for neurodivergent or mobility-impaired participants.

2. *Misaligned Goals*: The focus on constructing a sensory trail moved attention away from equitable decision-making, risking tokenistic participation rather than meaningful collaboration.

3. *Process Overlooked:* The project prioritised a final "output" (the trail) rather than creating a reproducible method for inclusive biodiversity planning.

This rejection of the trail concept became a turning point. By analysing its shortcomings, we recognised the need for a structured approach that integrates ecological knowledge with community empowerment. Traditional biodiversity interventions often marginalise neurodivergent and disabled voices, relying on top-down designs that fail to address diverse needs. For example, projects may select plant species for ecological value alone, neglecting sensory accessibility or maintenance burdens on participants.

Our shift to a co-design framework addressed these gaps by institutionalising participatory principles. The framework's development was guided by two key lessons from the trail proposal:

- Inclusivity Requires Structure: engagement risks excluding marginalised groups; a phased process ensures consistent, accessible participation.
- Equity Drives Sustainability: Projects shaped by stakeholders' lived experiences create long-term relevance.

This shift reflects broader trends in biodiversity planning, where co-design is increasingly seen as vital for addressing complex socio-ecological challenges. By centring flexibility and iterative feedback, our framework reimagines biodiversity interventions as collaborative processes rather than predetermined outcomes.

What Makes Biodiversity Interventions Inequitable And How We Can Fix It

While biodiversity initiatives in universities often aim to be inclusive, many students still face systemic obstacles that limit their ability to engage meaningfully. In this section, we identify and analyse three key barriers:

Lack of meaningful participation

Sensory inaccessibility

Absence of inclusive co-design

These barriers reflect deeper systemic biases embedded within environmental and biodiversity interventions. Such projects often assume a normative participant – non-disabled, neurotypical, and financially secure – overlooking the diversity of the student population. Without explicit attention to accessibility and lived experience, interventions risk reinforcing exclusion. Addressing these roots is essential not only ethically but for creating sustainable, effective, and socially just biodiversity practices.

Problem A
Participation Gap: Who Gets to Be Involved in Biodiversity

Despite growing efforts to promote biodiversity in higher education, engagement remains limited, especially among neurodivergent students, disabled students, and those from low-income backgrounds. These groups are often missing from sustainability campaigns, nature projects, and outdoor research, not because of a lack of interest, but because of layered and intersecting barriers.

One key barrier is physical and sensory inaccessibility. Many biodiversity initiatives take place outdoors, in remote areas or rugged terrain, making participation difficult or even unsafe for students with mobility limitations, sensory sensitivities, or anxiety. As Kane et al. (2020) highlight, poorly designed sensing environments can significantly reduce autonomy and inclusion.

Social and psychological barriers further reduce engagement. When students don't see others like themselves in these spaces – in terms of background, ability, or identity – they may feel out of place. Neurodivergent students, in particular, report feeling anxious in unclear settings or when expected to self-disclose support needs (Clouder et al., 2020). Financial barriers add another layer of exclusion. Many biodiversity opportunities require travel, unpaid labour, or equipment purchases. For students balancing studies with paid work, these conditions create impossible choices.

Together, these structural barriers are not isolated but interact and reinforce each other, shaping who is invited – and who is truly able – to participate in biodiversity initiatives. Tackling compounded exclusion requires proactive planning, clear communication, and a holistic, inclusive design approach from the outset.

Problem B
Sensory Barriers for Neurodivergent Students

Biodiversity spaces are not always built for sensory inclusion. For neurodivergent students, elements like harsh lighting, loud noise, chaotic layouts, or unpredictable sensory input can create environments that feel overwhelming or unsafe.

While sensory-friendly environments – such as therapeutic gardens – are gaining recognition (Gonzalez et al., 2013), most campus biodiversity interventions still ignore sensory access. As Finnigan (2024) notes, successful design must take both hypersensitivity and hyposensitivity into account. For example, traffic noise, crowds, flickering lights, or overpowering scents can quickly turn a green space into a stressor. On the other hand, positive sensory experiences – gentle textures, soft contrasts, natural sounds – can create calm, regulation, and engagement.

These gaps are not random oversights but stem from deeper biases within environmental design practices. Crucially, sensory barriers are often overlooked because environmental design privileges the sensory experiences of the neurotypical majority. The invisibility of sensory needs in planning stages reproduces exclusion – even when intentions are inclusive.

Designing truly accessible biodiversity spaces requires not only technical adjustments but genuine engagement with user experience. The effectiveness of a sensory space depends on its co-creation with those who actually experience sensory overload or under-stimulation. Without this, sensory features risk becoming performative or exclusionary.
 A truly accessible biodiversity intervention must address sensory comfort as a core design principle, not as a bonus feature. This means offering choice, predictability, and environments that feel safe for a range of sensory profiles

Problem C
# A Missing Process: Inclusive Co-Design

Even when biodiversity spaces are more accessible, a deeper issue remains: they are still too often designed *for* marginalised students, not *with* them.

Conventional projects typically invite input at the very end – in the form of surveys or feedback forms. This approach offers limited influence and often results in spaces that miss the mark. For students who already feel excluded from academic environments, this tokenism can reinforce disengagement.

Inclusive co-design offers a transformative alternative. Instead of adjusting plans afterwards, it centres lived experience from the start. Fotheringham et al. (2023) and Le Cunff et al. (2023) show how co-design, when based on structured workshops and flexibility, empowers neurodivergent participants to shape outcomes directly.

What does this look like in practice? It means creating design processes that allow non-verbal input, that are paced thoughtfully, and that invite different modes of expression – like mapping, modelling, drawing, or storytelling. It also means allowing students to choose how and when to contribute.

Co-design is not just about inclusion – it's about power. When students are truly invited into the design process, the results are not only more accessible but more relevant, used, and sustainable.
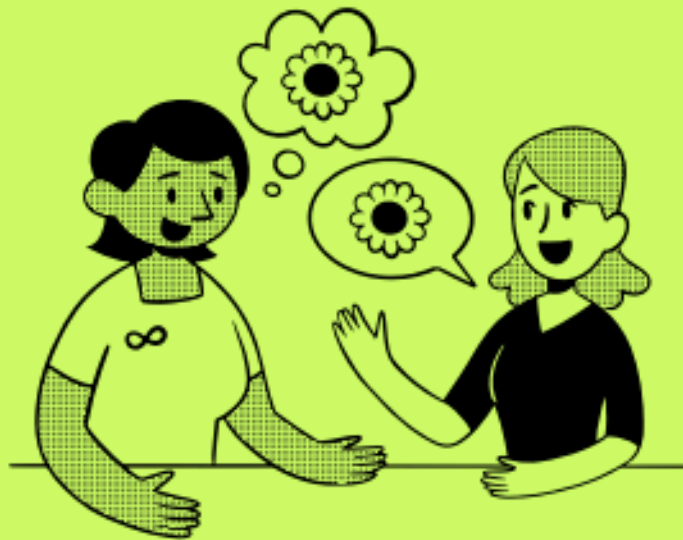
Our Solution: The Inclusive Co-designing Framework

Our framework rethinks biodiversity projects as collaborative, inclusive procedures. Developed to address systemic barriers faced by neurodivergent students, it prioritises participatory decision-making and adaptive design over fixed outputs. The framework consists of four phases, ensuring projects are shaped by ecological expertise and community needs.

Unlike traditional biodiversity initiatives, which often rely on limited consultation or retrospective adjustments, our framework embeds lived experience and inclusivity from the beginning. It treats co-design not as an optional enhancement, but as a foundational principle necessary for creating spaces that are ecologically effective and socially equitable. By centring flexibility, sensory accessibility, and participant leadership, the framework establishes a scalable model that can transform how biodiversity interventions are imagined and delivered.

Phase 1: Outreach & Recruitment

This phase ensures broad and inclusive participation from the start. Partnerships with university services, neurodivergent student groups and well-being advocates help build trust and identify relevant stakeholders.
 Outreach strategies include plain-language invitations, visual materials, and low-pressure sign-up options. Participants can indicate access needs (e.g. quiet space, breaks, alternative communication formats) in advance, ensuring the process meets diverse preferences.

Phase 2: Co-Designing Workshops

Workshops form the core of the framework and are designed to enable active, meaningful engagement between participants and experts. They are sensory-friendly, highly flexible, and centred on creative, participant-led design methods.

Workshop 1: Introduction & Shared Understanding (1.5 hours)
The first workshop introduces participants to the project, clarifies expectations, and creates a foundation for collaboration. After a welcome and overview, a "needs check-in" allows participants to express what would make the process accessible for them. This can be done verbally, in writing, or visually.

Biodiversity and accessibility experts then offer short, accessible inputs that set the ecological and participatory context. A guided walk of the potential site helps participants connect to the space through sensory observation — exploring light, textures, sounds, and movement patterns. The workshop closes with time for reflection and informal feedback.

Workshop 2: Co-Creation & Design Exploration (2 hours)
The second workshop invites participants to explore ideas and express preferences through creative, non-verbal methods.
Activities include:

- Sensory Mapping: Participants indicate calming or stimulating zones and sensory preferences on a large site map.
- Prototyping: Using materials like LEGO, clay, natural objects, or collage, participants create representations of features they'd like to see (e.g. tactile planting areas, shaded paths, quiet zones).
- Idea Clustering: In small thematic groups, ideas are clustered and combined, supported by facilitators and biodiversity experts who provide ecological feasibility input.

Workshops are moderated with attention to pacing, optional breakout spaces, and multiple communication channels. Participation is not performance-based — all contributions, whether verbal or non-verbal, are equally valued.

Phase 3: Finalising the Design

Insights from the workshops are translated into a draft plan by biodiversity professionals. This design is then shared with participants via accessible formats — such as visual summaries, annotated site plans, or audio walkthroughs.

Participants can give feedback asynchronously, ensuring that those unable to attend in person still shape the outcome. Final refinements are made based on this input, balancing ecological goals with lived experience.

Phase 4: Implementation & Stewardship

The implementation phase focuses on translating co-created ideas into practice through an accessible and collaborative process.

Key priorities include:

- *Inclusive delivery*: Activities such as planting, construction, or installation are organised with flexible, small-group formats, ensuring accessibility and comfort for diverse participants.
- *Participant agency*: Final choices — such as plant selection, sensory features, or spatial layouts — remain guided by participant input to maintain ownership throughout implementation.
- *Accessibility of outputs*: Physical features (e.g., pathways, signage, sensory installations) are designed following universal accessibility principles, incorporating elements like Braille, large print, and clear tactile markers.
- *Initial engagement in care*: Opportunities for participants to engage in early stewardship (e.g., planting, initial maintenance) are provided flexibly to support a sense of shared responsibility from the beginning.

This practical focus ensures that the transition from design to implementation sustains the collaborative and inclusive ethos established during earlier phases.

Case Study Proposal:
A Pollinator-Friendly Sensory Garden

As a first application of our Inclusive Co-Design Framework, we propose a sensory garden co-designed with neurodivergent students and staff at the University of Edinburgh. Through flexible co-design workshops, participants would map sensory needs, prototype ideas, and collaborate with biodiversity experts to create a space that supports both sensory accessibility and ecological goals.

Key features would include accessible pathways, sensory zones tailored for diverse sensory profiles, pollinator-friendly planting, and inclusive signage using Braille and large print. The project would not only provide a therapeutic and biodiversity-rich environment but also serve as a replicable model for inclusive biodiversity interventions, advancing the goals of the University's Sustainability Department and its commitment to becoming a Nature Positive University.

Making Biodiversity Interventions Inclusive: How Our Framework Responds to Key Barriers

Our Inclusive Co-Design Framework fundamentally shifts how biodiversity interventions are conceived, embedding participant input, flexibility, and accessibility from the very beginning. Unlike traditional approaches where participation is treated as an optional add-on, our framework treats lived experience as foundational to planning, ensuring interventions are shaped by the needs and priorities of diverse communities.

Key innovations include multi-modal engagement (through speaking, writing, drawing, sensory mapping), iterative feedback loops, flexible commitment accommodating fluctuating energy levels, and sensory-conscious design creating predictable, inclusive environments. These principles not only ensure immediate accessibility but also foster long-term adaptability as community and ecological needs evolve.

Applied to the barriers identified earlier, this framework directly addresses systemic gaps in biodiversity initiatives:

- *Participation barriers*: By involving neurodivergent and marginalised students throughout the design and implementation process, engagement shifts from symbolic consultation to genuine shared authorship.

- Sensory inaccessibility: Through co-designed sensory mapping and prototyping, spaces are shaped to accommodate a wide range of sensory profiles, offering choice, predictability, and comfort.

- *Lack of inclusive design processes*: Instead of retrofitting accessibility, the framework centres inclusion from the outset, challenging structural exclusion and enabling students from underrepresented backgrounds to see themselves as rightful stakeholders.

Thus, the framework moves beyond addressing immediate accessibility needs – it lays the groundwork for biodiversity interventions that are socially just, ecologically resilient, and replicable across diverse settings such as parks, urban green spaces, and future university projects. By reimagining participation as structural, not symbolic, our framework establishes biodiversity spaces that are sustainable not only ecologically, but socially.

Supporting the UoE's Vision for Inclusive and Nature-Positive Biodiversity

Our co-design framework was developed in direct response to the aims and priorities of the University of Edinburgh's Department for Social Responsibility and Sustainability. It offers a practical and scalable tool to help the Department translate its commitments to biodiversity, inclusion, and social justice into actionable, community-led interventions.

Specifically, the framework supports the Department's goal of embedding equity, diversity, and accessibility across environmental initiatives. By involving neurodivergent and marginalised students from the earliest design stages, the framework ensures that campus biodiversity spaces are shaped collaboratively, not imposed top-down.

It also advances the University's commitment to the Nature Positive Universities initiative by promoting biodiversity actions that are ecologically effective and socially sustainable. Projects developed through this framework actively demonstrate how biodiversity enhancement and inclusivity can be integrated rather than treated as separate goals.

Moreover, the framework contributes to several Sustainable Development Goals (SDGs) at a local level:

- *SDG 4 (Quality Education):* Supporting inclusive learning and engagement opportunities.

- *SDG 10 (Reduced Inequalities):* Addressing structural barriers to participation.

- *SDG 15 (Life on Land):* Enhancing biodiversity through sustainable, community-informed practices.

- *SDG 3 (Good Health and Well-being):* Promoting mental health through sensory-conscious green spaces.

By applying this framework, the Sustainability Department can strengthen its leadership role within the University and set a model for how biodiversity initiatives can be inclusive, impactful, and future-oriented.

Conclusion

This report began by identifying the systemic obstacles that prevent marginalised students — particularly those with neurodivergence, disabilities, or from low-income backgrounds — from meaningfully participating in biodiversity initiatives. As discussed in the introduction, many traditional intervention models unintentionally exclude these groups because they fail to prioritise accessibility, sensory inclusiveness, and participatory decision-making. These issues are not isolated to a single institution but represent broader patterns across many organisations engaged in biodiversity work.

Through this critical reassessment, the report proposed a practical and scalable solution: an Inclusive Co-Design Framework, applied here through the case study of a sensory garden. By centring lived experience at every stage of planning and implementation, the framework eliminates physical, sensory, and social barriers that have historically restricted access. The proposed Sensory Garden — with its adjustable lighting, quiet spaces, and multiple sensory pathways — would not merely accommodate diverse needs but create an environment where neurodivergent students lead decision-making processes, shifting participation from symbolic engagement to genuine co-creation.

Furthermore, the framework's flexibility and adaptability ensure that it can be expanded and adapted across different contexts, such as schools, parks, university campuses, and broader community spaces. It demonstrates that true inclusiveness must be embedded from the beginning, through collaborative conception, responsive design, and continuous feedback loops, rather than being retrofitted afterwards.

Ultimately, this report argues that effective and equitable biodiversity interventions must move beyond tokenistic inclusion towards authentic co-creation. When marginalised students are not simply passive recipients but active shapers of biodiversity spaces, these spaces become more just, resilient, and reflective of the diverse communities they aim to serve. What began as a critique of systemic exclusion has evolved into a transformative, feasible proposal: a biodiversity initiative that embraces cooperation, celebrates difference, and builds a more sustainable and equitable future for all participants

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