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Opportunities for science centers and museums to cultivate a culture of climate action

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Science centers and museums are uniquely positioned to spark climate action. In this commentary, we describe opportunities to further increase the field's impact through research on the psychological states that drive action and public engagement approaches for sparking those states. We also introduce Seeding Action, an initiative led by the Association of Science and Technology Centers to address the opportunities for cross-museum research and coordination.

Science centers and museums are creating pathways for climate solutions by supporting their community members to take collective climate action. For example, the Science Museum of Virginia[1] and Natural History Museum of Utah[2] are among a large number of institutions that have led efforts with their communities to document urban heat island effects, generating data that inform local decision-making. The Wild Center in Tupper Lake, NY[3], and Quest Science Center in Livermore, CA[4] are two of many organizations that have hosted Youth Climate Summits that create the scaffolding for high school students to build community and develop climate action projects. Other museums, science centers, and nature centers, such as the Nurture Nature Center in Easton, PA[5], and the Museum of Science Boston[6] have hosted community dialogue events that bring together policymakers, scientists, and members of the communities most affected by climate impacts to deliberate about and inform local policies. Across these varied contexts and locations, science centers and museums have played a leading role in designing, convening, and facilitating opportunities for collective climate action.

Science centers and museums make a unique impact

Science centers and museums are uniquely positioned to spark climate action for several reasons. For one, they have distinctive presences in their communities as institutions that are often well-known locally because of their extensive programming, wide-ranging cross-sector partnerships, and history of involvement in local issues. Accordingly, they stand to be familiar messengers, partners, and conveners with local expertise, poised to create relationships and action opportunities.

Second, science centers and museums encounter large swathes of the public. According to a survey by Wilkening Consulting[7], in a typical year, 25–31% of adults in the United States report visiting a museum, with many more interacting with museum staff or content off-site and online. Museums and science centers simultaneously serve diverse audiences and particular segments of the public who are especially likely to engage in climate action, as museum visitors tend to have more extensive understanding of climate change and willingness to act than the broader public[8]. Children make up another significant audience for science centers and museums, which is notable because this demographic is increasingly concerned about climate change and eager for opportunities to act[9]. Relatedly, science centers and museums reach parents and caregivers, many of whom want to help children become planetary stewards[10] and may thus be particularly receptive to messages and opportunities to engage in climate action.

Third, science centers and museums can spark action in a range of ways given the diversity of their programming, content areas, and resources. While exhibits are some of the most well-known ways that people experience science centers and museums, these organizations also regularly host events, conduct research, participate in local coalitions, develop curriculum materials, and more, each of which provides opportunities to engage with different groups of people and opens possibilities for different types of action[11–13].

Knowledge gaps pose barriers to widespread action

While independent evaluations reveal that many science center- and museum-led efforts do indeed catalyze action, critical research gaps limit the impact of the science center and museum field as a whole and point to the importance of attending to the various ways these institutions can contribute to climate action[14]. Our collective capacity to make an impact would benefit from more robust research exploring two high-level questions: (a) what are the psychological states that drive different people or communities to participate in various forms of climate action (both in and outside of museum contexts)? And (b) what are the attributes of the interventions that museums can implement through their content and programs to influence those psychological states? Here, we address the research related to these lines of inquiry alongside the open questions.

First, what are the psychological states that influence different people or communities to participate in various forms of climate action? A substantial body of work explores the social, cognitive, and affective factors that are *associated* with pro-environmental action, and with collective action more broadly. These factors are generally measured through self-report data and correlational analyses. For example, a meta-analysis by Hines, Hungerford, and Tomera revealed that knowledge of issues, knowledge of action strategies, a strong internal locus of control, a verbal commitment, and an individual sense of responsibility are all associated with certain pro-environmental behaviors[15]. Other internal variables that have been empirically associated with action include motivation, values, attitudes, and emotional involvement[16].

However, research on the causal influence of factors like these on real-world behavior has been minimal and inconclusive[17]. In a 2022 study by Castiglione and colleagues that manipulated the psychological states targeted by various interventions, none significantly influenced the behavior

measured, in this case, attendance at an advocacy group meeting. The limitations of existing research point to the need for studies that manipulate interventions that influence various psychological states and measure real-world behavior at subsequent time points.

Second, what are the attributes of the interventions that museums can implement through their content and programs to influence the relevant psychological states? Museums' programmatic and exhibit evaluations offer evidence that their public engagement efforts can catalyze public action. For example, a suite of climate science and resiliency-themed programming developed by the Science Museum of Virginia directly facilitated action by providing opportunities for community members to participate in a community-based participatory research study and provided several distinct educational programs that increased participants' ability to promote climate resilience behaviors[18]. Similarly, following a Youth Climate Summit at The Wild Center, external evaluation by Kera Collective revealed that many of the high school-aged participants reported undertaking and sustaining a wide range of actions (e.g., testing water quality in local lakes, increasing local recycling collection, sharing their climate stories with others).

Though these studies demonstrate *that* museums and science centers can catalyze action, the field would benefit from more research on the conditions under which they do so most effectively. Field-wide evaluation practices often measure the most immediate metrics (e.g., time spent in an exhibit, visitor satisfaction following a program) and do not enable attribution of various outcomes to specific features of the program or exhibit design. These limitations give rise to a lack of clarity related to the attributes of the interventions that museums can implement through their content and programs to influence public action.

To effectively support their communities in action, museums would benefit from research on the influence of various psychological states on action, and the attributes of museum-based interventions that bring about the influential psychological states.

These understandings will pave the way for responsive, evidence-based content and programs that maximize science centers' and museums' collective impact.

Increasing pathways to action through research and coordination

The research described above is one component of a strategy to increase science centers' and museums' abilities to foster a culture of climate action. The other critical component of such a strategy is to improve the coordination of messages, approaches, and data across institutions. As the research gaps described above are addressed, the field will have increasing clarity about specific outcomes they might strive to cultivate for participants in different contexts, the attributes of public engagement approaches that are best positioned to give rise to those outcomes, and practices for measuring those outcomes. Learnings must be shared across institutions, to ensure that research informs practice as efficiently as possible.

In response to the need for cross-museum research and coordination, ASTC launched Seeding Action in 2023 to strengthen science centers' and museums' impact on planetary health. The initiative aims to support and catalyze efforts at science centers and museums that cultivate a *culture of action*, one in which people of all backgrounds see themselves as actors who have the power to participate in collective action and do so regularly.

Seeding Action simultaneously advances research and coordination through a suite of complementary efforts. The foundation of the initiative is comprised of activities that strengthen relationships across organizations, enable the exchange of insights related to promising practices and overcoming challenges, spark inspiration for new approaches, and surface opportunities for cross-museum collaboration. These opportunities take the form of in-person and virtual workshops and trainings, facilitated networking events, and presentations.

Seeding Action also supports the coordinated implementation of evidence-based public engagement approaches by developing adaptable resources that can be used in diverse settings, such as a summaries of communication strategies that increase climate understanding, concern, and commitment to action, and a guide for leveraging data from the United States Fifth National Climate Assessment to spark conversations about local climate action through various types of museum programs (e.g., field trips, dialogs and deliberations; both resources can be found at https://seeding-action.org/resources). As the initiative expands, we plan to lead the development of increasingly robust content and programs that can be adapted by museums, science centers, and other public engagement organizations.

In addition, Seeding Action administers an annual survey and conducts interviews with museum staff on all dimensions of their planetary health work, including their content and programs, partnerships, research and evaluation, and facilities and operational decisions. This effort supports institutions to assess their planetary health efforts, reflect on priorities and lessons learned, and increase internal alignment among their staff. These data also provide Seeding Action with a rich and nuanced understanding of field-wide practices, challenges, and opportunities, in turn ensuring that the efforts described above are responsive to members' priorities and possibilities.

We have begun to take up the questions described here with a suite of interdisciplinary, cross-sector partners, allowing us to adopt a mixed-methods approach (e.g., surveys, ethnography, interviews, and textual analysis) and to bring a range of perspectives and expertise to bear on these multi-faceted open questions. Our co-creative, adaptive approach ensures that research and implementation are mutually reinforcing and ultimately strengthens the capacities of science centers and museums to contribute to a culture of climate action.

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