

A Youth Advisory Research Board in a science center: an empowering setting for collective action

Report of research findings from

Youth Lead the Way:

A Youth Advisory Research Board Model for Climate Impact Education

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With generous support from the National Science Foundation



This material is based upon work supported by the National Science Foundation under Grant No. DRL-2005678. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



Abstract

Responding to urgent climate-related needs, youth around the world are leading collective action by promoting civic engagement. Recognizing youth potential to accomplish even more, the informal STEM learning (ISL) community can partner with and learn from young climate leaders while sharing resources specific to our field. This paper describes how a collaboration between youth and a science center supported youth empowerment related to collective climate action, and the resulting local model for empowering settings (Figure a).

This research focused on Youth Lead the Way: A Youth Advisory Research Board Model for Climate Impact Education, a collaborative effort between youth, the Oregon Museum of Science and Industry (OMSI), and other partners. Youth Lead the Way merged two well-established methods—Youth Advisory Boards and Youth Participatory Action Research—into an innovative Youth Advisory Research Board (YARB). As a result, the youth led climate impact education and advising while OMSI both supported and learned from these young people.

Guided by the question, “What factors of the YARB contribute to youth engagement and empowerment in a collective action context,” this research was informed by bodies of theory related to empowerment and ISL professional development along with interviews, surveys, focus groups, and group chats from the youth cohort members. The practical factors identified by the youth were synthesized into four conceptual categories of empowering settings identified in prior research by Maton (2008): Belief Systems, Relational Environments, Core Activities, and Opportunity Role Structure.

Importantly, the youth identified empowering factors of the OMSI YARB that are specific to collective climate action. Some examples include: having the agency to direct their program for community climate action and impact, making connections with others invested in climate action, strengthening capacities to educate close community members on climate change, and engaging with the public as changemakers and ISL professionals.

Overall, the OMSI YARB model developed through this research contributes practical information that can help science center staff partner with, learn from, and support youth through empowering settings. It also elucidates relationships between conceptual and practical variables that can serve as the basis for further research; for instance, these researchers specifically identified an opportunity to better understand and refine relationships between ISL professional competencies, organizational characteristics, and practical factors in empowering settings for collective climate action.



Evidence-based details of an empowering YARB setting

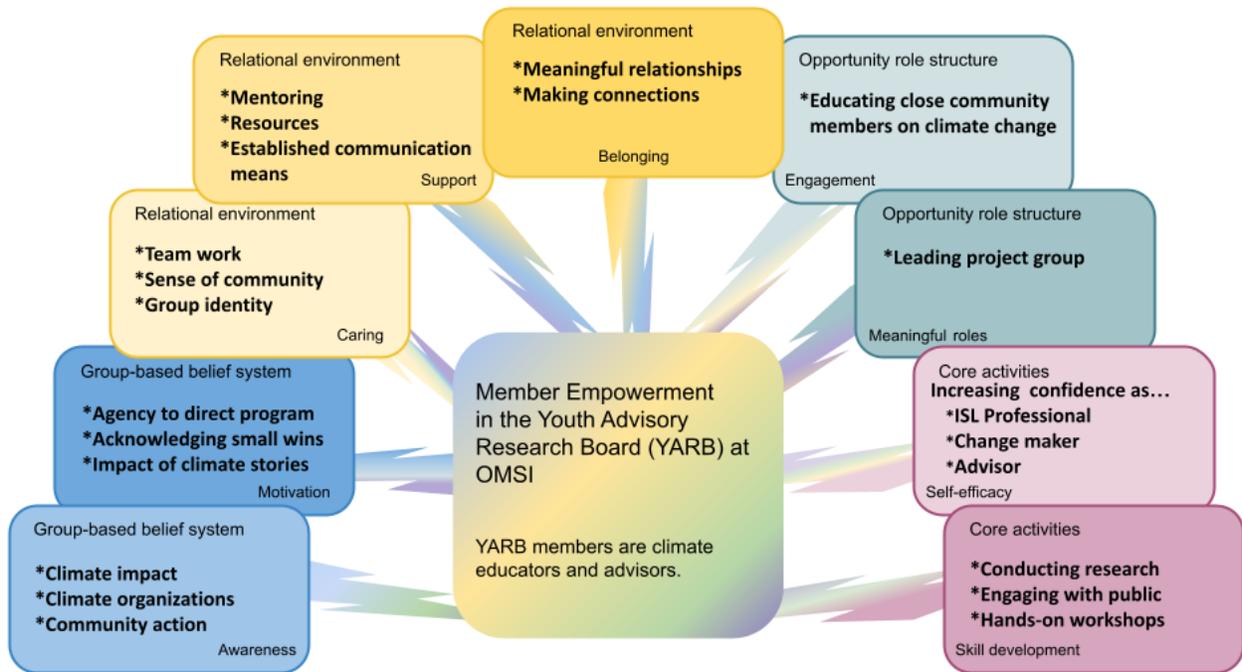


Figure a. Model of Youth Advisory Research Board (YARB), with evidence-based details of an empowering YARB setting at OMSI (identified by asterisks [*]). Adapted from Maton, K.I. (2008), Empowering Community Settings: Agents of Individual Development, Community Betterment, and Positive Social Change. American Journal of Community Psychology, 41: 4–21.



Acknowledgements

The authors would like to acknowledge the contributions of the Youth Lead the Way youth, staff, partners, and advisors involved in this research. The authors thank the Oregon Museum of Science and Industry and the National Science Foundation for their support.



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Introduction: Project context and objective

General considerations

We stand at a point in history when broad, systemic, evidence-based action is needed to respond to changes in our global climate (Intergovernmental Panel on Climate Change, 2023). This work requires leadership and involvement from community organizations and the public alike, and cannot be achieved by anyone acting alone. While individualized actions—such as recycling or driving a hybrid car—are worthy efforts, dramatically reducing global carbon emissions will require *collective action*: individuals working together at various levels to change the social and political structures that enable excessive carbon emissions (Ockwell et al., 2009; Ostrom, 2010). This work must be based on sound science, and it must take into account the needs of all community members, especially the vulnerable and the marginalized.

Though a climate movement is growing in the US, there remains significant room to increase public participation. One factor hindering collective action is confusion about the science of climate change. As of 2019, 69 percent of Americans believe climate change is occurring, but only 52 percent correctly attribute it primarily to human activity (Leiserowitz et al., 2019). Climate literacy is confounded by the scientific complexity of the issue as well as overt campaigns of misinformation (Dunlap & McCright, 2010). A study by the FrameWorks Institute found that most Americans fail to understand the causes, mechanisms, and risks associated with climate change (Bales et al., 2015). In short, there is a gap between what scientists know to be true about climate change, and what the public understands about it.

In order to improve public understanding of the problem, climate change communication *should* address cognitive gaps and misperceptions. However, extensive research acknowledges that climate literacy, while important, is insufficient to spur climate-related activism (Kahan et al., 2012; Ockwell et al., 2009; Roser-Renouf, et al., 2014). Civic engagement requires time, money and skills, and these resources are disproportionately distributed—with adults, higher-income individuals, and dominant culture individuals having greater access than youth, lower-income individuals, and minoritized individuals (Brady et al., 1995).

ISL (informal STEM learning) institutions, such as science centers, are uniquely situated to play a significant role in promoting collective public response to the problem. The theory of civic science argues that the public should have a stake in the processes at the intersection of policy and science (Bäckstrand, 2004), a notion that seems to align with the distal goals of the Youth Lead the Way project. We must find new ways in which, “scientists and citizens can work in a collaborative spirit to create common resources that support science-driven, civic outcomes.” (Garlick and Levine, 2016, pp. 693–694). For science centers, this is by



centering citizens—including youth—as experts and leaders in scientifically informed action.

Major moves towards civic participation in climate science are apparent from youth-led climate organizations. Compared to adults, today’s youth will disproportionately experience the effects of climate change. This is particularly true for youth in frontline communities, who experience “first and worst” the effects of climate change (Holland, 2017). These youth know—and will testify to—the scientific consensus that climate change is not a future, abstract phenomenon, but a real threat; one that is occurring now and will only worsen without collective public response. Groups like Zero Hour, The Youth Climate Strike, Sunrise Movement, and many other networks have generated recognition for climate change and created opportunities for youth civic engagement through public rallies, lobbying, and community organizing.

Young climate activists bring a grassroots, highly localized perspective of climate impacts and opportunities for climate action. For example, the lobbying efforts of teen-led Utah Youth Environmental Solutions were instrumental in passing a state legislative resolution that explicitly recognizes the threat of climate change and encourages the reduction of emissions (Ramadan, 2019). In Portland, Oregon, high school activists successfully lobbied the school district to update its policies, allowing students an excused absence to participate in the Youth Climate Strike (Portland Public Schools, 2019).

There is an opportunity for the ISL community to learn from these young climate leaders while further empowering them with resources specific to our field. One of these resources is social capital; science centers experience broad public approval and are seen as trusted sources of science information (American Academy of Arts and Sciences, 2018, 2019). They have access to a large audience and can provide a platform for youth voices that might otherwise go unheard. Additionally, science centers are staffed by experts with training in science communication and/or social and natural sciences research and they have the resources to help youth hone their message and develop effective, evidence-based storytelling around climate change. Science museums can be connected in the local Science, Technology, Engineering and Mathematics (STEM) ecosystem, maintaining active partnerships with schools, nonprofits, government agencies, professional scientists, and other ISL organizations. They can help youth become aware of, and gain access to, certain opportunities for engagement that may have been previously invisible or inaccessible (Prince, 2019). And lastly, science centers can offer youth financial support, a lack of which can be a barrier to engagement.

In this context, *Youth Lead the Way: A Youth Advisory Research Board Model for Climate Impact Education*, hosted by the Oregon Museum of Science and Industry (OMSI), offered a theory-based approach for youth from communities underrepresented in STEM to



conduct content research on local climate change impacts and develop interactive educational products designed to engage public audiences around these impacts. Through the Youth Lead the Way project, a program that supports youth and science center collaboration was developed and implemented by integrating two well-established methods: Youth Advisory Boards and Youth Participatory Action Research. Through Youth Advisory Boards, young participants can influence real, observable change. Through Youth Participatory Action Research, participants are positioned as experts, creating knowledge that further influences social change (Cammarota & Fine, 2008; Ozer, 2016; Powers & Allaman, 2012). The innovative merging of Youth Advisory Board and Youth Participatory Action Research Board is captured in the term Youth Advisory Research Board (YARB).

To document a local YARB model that can contribute to future research and application of YARBs, the Youth Lead the Way project included an early stage research study, described in this paper. The research methods for this project included ongoing reading of literature, collecting data with youth, and revising the local OMSI YARB model. The project's initial visioning was motivated by literature about civic science (Bäckstrand, 2004), collective action (Ockwell et al., 2009; Ostrom, 2010), and public engagement (Bales et al., 2015; Geiger et al., 2017). From this broad literature, the researchers refined their focus to theories related to empowerment and ISL professional development. This research aimed to develop a descriptive model of the OMSI YARB that systematically identified and characterized the local factors of the OMSI YARB that contributed to youth engagement and empowerment in a collective action context. Interviews, surveys, focus groups, group chats among youth cohort members, and review of artifacts generated by the youth also informed this early stage study.

By supporting youth empowerment, a YARB has the potential to influence staff at an ISL institution and community partner organizations, as well as members of the public, to engage more effectively with learning experiences about local climate impact. While the findings from this project are early stage, they provide the ISL field with the OMSI Youth Lead the Way program example (OMSI, 2023b; Reilly, 2023), youth advice for working with youth (OMSI YouthCARE team, 2023), evaluation reports on the lessons learned from the Youth Lead the Way program (Herrán et al., 2023), and this early-stage research report on the factors identified from the OMSI YARB that support youth empowerment. This report describes the research methods and the resulting evidence that informed the local OMSI YARB model.

In this paper we use the term “YARB” to refer to YARB-related activities that happened from the youth point of view, as the YARB was the youth’s center of operation. We use the term “Youth Lead the Way program” to refer to activities that happened from the adult point of view, because the adults were present only to provide programmatic support for the OMSI YARB. Therefore, the same activity, such as youth-staff communications, could be referred



to as a YARB activity or a Youth Lead the Way program activity, but the perspective we study is what distinguishes it. For example, the project evaluation focused on the Youth Lead the Way program activities in that it studied program support provided by adult staff (Herrán et al., 2023). On the other hand, this research focused on the YARB activities in that it studied the youth perspectives on factors that supported engagement and empowerment for YARB members. This paper uses the term “YARB model” to refer to the emerging and resulting theory- and evidence-informed model of YARB member empowerment, which prioritizes youth self-report, developed through this study of the YARB.

Project overview

As mentioned above, the Youth Lead the Way project aimed to address the need for collective action around climate change and to leverage the unique roles of youth and ISL institutions in the climate movement. For the purposes of the project, collective action is defined as people working together, in an informed, evidence-based way, to positively change their community. The Youth Lead the Way project supported collective action at multiple levels and intersections—youth working together, with OMSI, with community partners, and with the public. This research focuses on the core of this collective action—the youth and their experience as part of the OMSI YARB.

The project included three interrelated strands—programming, evaluation, and research—that supported the development of the OMSI YARB experience, and informed the project deliverables and the local OMSI YARB model. Within the program strand, youth researched, developed and disseminated climate stories; advised other museum staff on a variety of issues (including how to work with young people); interacted with partners; and engaged in professional development. All these programmatic activities were youth-led, with support from adult museum staff. The evaluation strand explored elements that supported the development and improvement of the OMSI Youth Lead the Way program activities (Herrán et al., 2023). The evaluation strand also collected data from members of the public who interacted with the climate stories developed by the youth (Herrán & Shagott, 2023). The primary activities of the research strand included this qualitative study to create a local YARB model (see *General Considerations* section).

Fourteen OMSI YARB members (ages 16–21) were selected based on their experience with and/or interest in collective climate action, ability to describe how climate change affects them personally, and self-described affiliation with minoritized groups that historically have been underrepresented in both STEM (National Science Board, 2018) and environmental organizations (Taylor, 2014; Johnson, 2019). The formation of this cohort was a key commitment by OMSI to participate in climate action with the YARB leading as a connector and generator of collective action.



For 16 months of the project, this cohort of selected youth held paid employee positions at OMSI (14 youth were recruited for 12 months from July 2021 to May 2022; six of these youth continued for another four months from June 2022 to September 2022) as climate science educators and advisors for museum professionals. This period from June 2021 to September 2022 was during the global coronavirus pandemic and museum activities were reduced, but the youth were able to meet in person at OMSI for much of their program. The Youth Lead the Way program supported youth in building skills for success in both of these roles. In addition to numerous trainings on climate impact, science communication, research methods, storytelling, and leadership; youth learned by doing the actual work. Each role is described in more detail below.

Advising

To select their advising roles, OMSI YARB members were provided with a short list of museum projects related to collective or climate action and their possible needs. From this list each participant chose a project based on their interests and/or prior experience. Specifically, the youth provided guidance to their OMSI colleagues by reviewing and updating exhibit copy on exhibits related to the United Nations Sustainable Development Goals (United Nations, 2015); collaborated with the Exhibits team on developing sustainable exhibit fabrication practices; and took an active part in planning and implementing activities for community-based earthquake resilience.

Climate education and stories

With support from adult colleagues, youth worked to identify and research their own questions related to local climate change impacts (e.g. wildfires, urban heat islands) as well as opportunities for collective action in their communities. While more experienced staff coached youth to form appropriately focused research questions, select suitable methods, and utilize credible data sources; the inquiries and community connections were driven by the youth.

Drawing on the data and findings from their research projects, OMSI YARB members developed communication products called “climate stories.” Based on storytelling or public narrative, climate stories are powerful communication tools that have proven especially effective to mobilize people to participate in social movements (Diamond et al., 2013). Part of their climate communication approach focused on the National Science Foundation (NSF)-funded National Network for Ocean and Climate Change Interpretation (NNOCCI) framework, which has shown that incorporating a discussion of collective action into climate education efforts improves public understanding of the issue (Bales et al., 2015) and has significant potential to promote increased public engagement with climate change (Geiger et al., 2017).



The parameters for the youth-developed climate stories were intentionally broad, to allow for a wide variety of content related to climate change, as well as a wide variety of communication modes (for instance, video, games, and climate art gallery). These products were presented in multiple venues, including community spaces identified by youth and OMSI. The youth conducted formative evaluations on their stories and the evaluation team assessed how the Youth Lead the Way experience contributed to, hindered, or provided opportunities to elicit in youth skills that aligned with the project and youths' priorities (Herrán et al., 2023).

Methods

The processes used to create the local OMSI YARB model involved reading literature, collecting data, coding and interpreting the data, and modeling the OMSI YARB factors (Figure 1). These processes repeated several times throughout the research, leading to refinement of both the theoretical framing of the research and the model.

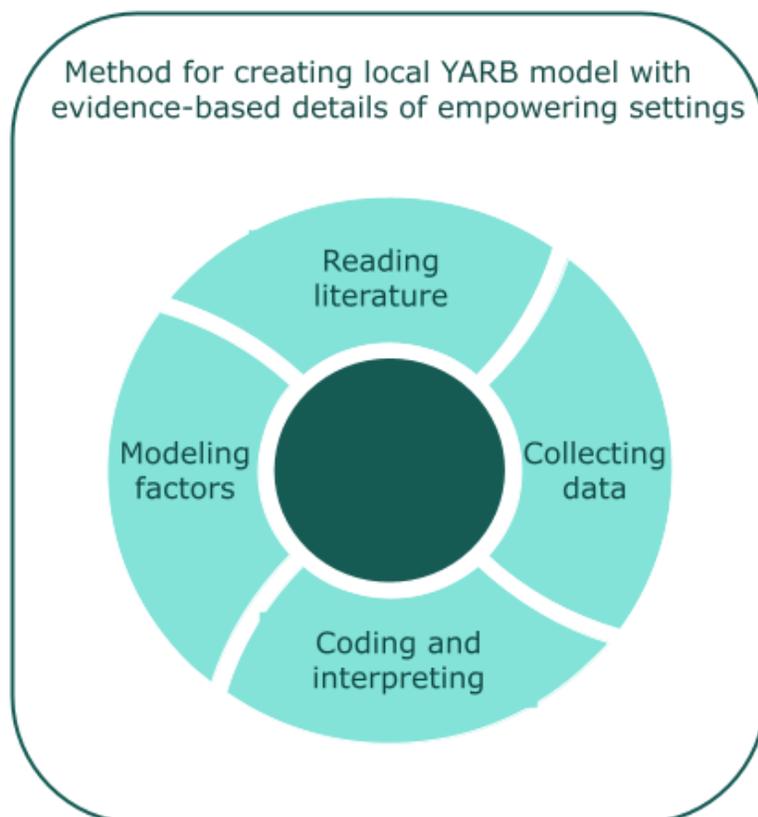


Figure 1. Method activities to study and model meaningful factors of the OMSI YARB.



Data collection

Data were collected for this research during 12 different data collection sessions between March 22, 2021 and August 3, 2022. Because it was believed that youth's notion of collective action would evolve, data collection sessions were dispersed throughout the Youth Lead the Way program experience, allowing researchers to gain a richer, more nuanced understanding of how the YARB setting supported youth. Across three of the sessions, 22 ISL professionals participated; and across the final nine sessions, 14 youth participated. The data collection activities used in this research included questionnaires, focus groups, and interactive activities. Some sessions were conducted virtually using web conferencing platforms. A more detailed account of each data collection session, and how literature informed data collection, is discussed below.

Collecting data related to engagement

Researchers reviewed literature about civic science, collective action, and public engagement to understand which factors in the OMSI YARB might provide positive impacts and outcomes for both the participating youth and the museum. The literature identified collective action—as opposed to individual actions—as a mitigator to the worst effects of climate change (Ockwell et al., 2009; Ostrom, 2010). As mentioned above, for the purposes of the project, collective action is defined as people working together, in an informed, evidence-based way, to positively change their community.

Based on the literature, the museum context, and the project's goals related to advising and research-based climate story creation, researchers developed an initial set of four groupings to organize the various factors important in the YARB model. These groupings included: Institutional-Related factors, Training-Related factors, Collaboration & Community-Related factors, and factors related to youth Climate Education Products. Factors related to these categories (e.g. advisory roles, skill development workshops, youth-led projects, collaboratively working with peers), along with subsequently collected data from museum professionals and youth, informed a first draft of the local YARB model. While this practice of revising the model was a key activity in the research methods—each data collection session described below informed and was informed by iterations of the model—we share only our final model at the end because the drafts fell short of coherence and meaning to benefit the field.

Session 1

Relevant OMSI professionals completed a questionnaire asking if the initial factors identified for the local YARB model resonated with them. Between March 22, 2021 and April 7, 2021, twenty-two museum employees and volunteers were recruited to fill out an online questionnaire hosted on Alchemer survey platform. It contained questions about each of



the four categories of initial factors, as described in the paragraph above, and their potential meaningfulness and impact for OMSI YARB members (*Appendix A*).

Session 2

The second data collection session took place on July 6, 2021. During this session, researchers facilitated a 90-minute virtual focus group (conducted over Zoom) with three museum employees who had participated in Session 1. As a follow-up to the questionnaire administered in Session 1, this session aimed to elicit elaborations on participants' responses about 1) the initial local YARB model factors, 2) additional factors that were proposed in the questionnaire, and 3) any additional ideas about the local YARB model.

The session started with an icebreaker where participants introduced themselves, their relationship to the museum and the natural ecosystem in which they most prefer to spend their time. Participants were then asked to describe the OMSI YARB as they understood it, as well as the significant outcomes and challenges they believed would be encountered in establishing a YARB at OMSI. The discussion was then directed to the local YARB model design factors they expected would have the biggest impact on outcomes. The final structured question asked participants to identify design factors that had not yet been discussed, and why those design elements may be important. The participants were then asked to provide any final thoughts or questions about the OMSI Youth Lead the Way program or the local YARB model design factors. A copy of the facilitation questions are in *Appendix B*.

Session 3

In Session 3, the focus was on gaining youth insights on factors that support youth engagement, which could be used to inform the local YARB model.

Data were collected on July 9, 2021, during which OMSI YARB members were asked to participate in a 60-minute virtual focus group over Zoom (*Appendix C*). The session focused on the youth's perspectives on youth engagement and the factors that support it. The session elicited responses to the following questions:

1. What themes or topics make you feel really passionate or engaged for a long period of time, more than anything else you've been doing?
2. When you think about these, what do you think supported your passion? What kept you engaged for a long period of time?
3. Thinking about the opposite, describe a time you felt engaged about something for some time, but then got discouraged. If so, what happened?
4. What are some resources that a museum can use to support your interests?
 - a. How can an institution make you feel heard and respected?



- b. What about the YARB, how can it support your engagement and be successful?

Session 4

During data collection on July 30, 2021 researchers facilitated a 60-minute virtual focus group over Zoom with six members of the OMSI YARB (*Appendix D*). The purpose of the focus group was to discuss the youth's experiences as members of the newly formed YARB. This discussion was guided by the following questions:

1. First, can you describe how your experience as a member of the YARB has been so far?
2. What aspects of the YARB experience have been most beneficial or rewarding to you?
3. Which of the aspects of the YARB do you think have the biggest impact on outcomes of the project (like your research processes and developed climate education products)?
4. What are some ideas about ways to improve future YARB programs?
5. Any final thoughts, comments, or questions regarding the YARB and/or your experiences?

Session 5

Data collection on September 11, 2021 focused on identifying YARB model factors suggested by the youth and gaining youth insights on factors that support youth engagement, which could be used to inform the local YARB model.

Seven OMSI YARB members participated in a 60-minute virtual focus group. To help ensure that all members were able to voice their thoughts, participants were asked to provide written answers to the facilitation questions prior to the session. These written responses were used to help guide the conversations and help the research team understand youth-identified YARB factors that support youth empowerment as climate impact educators. The discussion also covered YARB factors that support youth empowerment as ISL professionals engaged in climate impact education.

It should be noted that OMSI YARB members named their group Youth Climate Action Research Educators or YouthCARE. To respect their group identity, the guiding questions for this focus group (below) used the term YouthCARE when referring to the OMSI YARB for this cohort of youth.



1. In what ways, if at all, do you feel empowered as a climate impact educator through YouthCARE?
 - a. What factors contribute to developing as a successful climate impact educator?
 - b. Areas to consider: trainings, conducting your own research, advising with professionals, team-based inquiry evaluation
2. What impact has your experience in YouthCARE had on people besides yourself?
 - a. Think about your family and friends and also the general public you interacted with. Have they learned about climate change? Have they shown increased interest?
3. This is the first time we have conducted YouthCARE and we would like to know what youth can do to prepare for the program.
 - a. What advice would you give another generation of YouthCARE members, about how to prepare for the program?
4. What advice would you give to another generation of YouthCARE members about how to carry the program out?
 - a. Think about organizing, having ownership, being independent, asking for advice, etc.

Session 6

On September 24, 2021 researchers facilitated a 60-minute debrief with six OMSI employees who had worked with the youth during the summer of 2021. Data were recorded through the use of written notes of responses to the debrief prompts. The purpose of the debrief was to discuss the employees' experiences working with the OMSI YARB, and was guided by the following questions:

1. Can you describe how your experience working with the YARB has been so far?
2. Which of the model design factors of the YARB experience do you think have been most beneficial or rewarding to the YARB members?
3. Which of the model design factors of the YARB do you think is having the biggest impact on outcomes of the project (like the research processes and developed climate education products)?
4. Are there any design factors of the YARB program that seem to be missing at this point or that you think should have been included? What might those be and how do you think they are important?



Collecting data related to empowerment

As the project progressed, researchers realized that further development of the model would require stronger theoretical grounding than had previously been present in the model. Encouraged and guided by the youth data collected up to this point, the researchers adopted empowerment theory (Perkins & Zimmerman, 1995; Zimmerman, 2000) as the foundation upon which to further develop the local YARB model. Empowerment was recognized as a fundamental construct in collective action. Promoting “well-being and citizen control at the psychological, organizational and community levels, particularly for marginalized populations” (Christens & Peterson, 2012, p. 625), empowerment theory seemed to embody the intentions for the OMSI YARB.

Perkins’ and Zimmerman’s perspective on empowerment was congruent with the project’s intention for collective action. They state that *community* empowerment refers to “collective action to improve the quality of life in a community and to the connections among community organizations” (Perkins & Zimmerman, 1995, p. 571). Working with this empowerment lens, researchers began turning toward understanding the factors that the youth perceived as empowering.

Recognizing empowerment as a complex multidimensional construct that happens on individual, organizational, and community levels (Perkins & Zimmerman, 1995), the researchers had to prioritize the levels upon which they would focus their study. Because the research was intended to identify meaningful factors of the OMSI YARB, this research prioritized the organizational level (the YARB), from the perspective of the individual YARB members.

Integrating youth data with empowerment theory, project staff (other than youth) brainstormed additions to the OMSI Youth Lead the Way program (potential deliverables, suggestions for youth-led research, etc.) that might enhance both individual YARB member empowerment and organizational YARB group empowerment.

Session 7

On May 5, 2022 researchers facilitated a 60-minute activity with OMSI YARB members. Data were recorded through the written researcher notes. The purpose of the focus group was to understand the factors of empowerment for the OMSI YARB members as individuals. During the focus group the youth were shown factors (e.g. understanding of the socio-political environment, collaborative competence, sense of community) from the literature broadly associated with different levels of empowerment (i.e. individual, organizational, community). Along with the factors, the focus group was guided by the following questions:



1. What can OMSI help you do or what has OMSI done to help you empower yourself in these areas?
2. How do you recommend improving these areas?

Session 8

On May 7, 2022 researchers facilitated a 60-minute focus group with OMSI YARB members. Data were recorded through the written researcher notes. The purpose of the focus group was to understand what the youth identified as factors of the OMSI YARB that empowered the youth as a group. The focus group was guided by the following questions:

1. As YouthCARE, the group, what makes you feel empowered?
2. What are your thoughts as YouthCARE, about your relationship with OMSI?
3. What would be empowering for YouthCARE? What should OMSI do?

Session 9

On May 8, 2022 youth participating in the OMSI YARB were asked to self-facilitate a group discussion. Data were recorded through notes collectively written into a web-based questionnaire. The purpose of this discussion was to allow the youth an opportunity to reflect honestly on their experience in the YARB, without the presence of researchers or program coordinators. The discussion was guided by questions like these (see *Appendix E* for the full version):

1. Tell us about something that you were struggling with in YouthCARE.
2. How was your experience with YouthCARE programming?
3. How was your experience with YouthCARE advising (both advising projects)?
4. Do you have any thoughts on reaching communities you would like to share with us?

Collecting data related to member-checking

The activities described above provided structure and theoretical backing to the local YARB model; however the data these activities generated still did not theoretically articulate the components of the OMSI YARB that were factors of youth empowerment. This led researchers to conduct additional review of literature within the realm of empowerment theory.



As noted earlier, empowerment was recognized as a fundamental construct in collective action and the premise of the YARB. During this literature review, researchers identified the need to conduct a member-check with OMSI YARB members on agreed-upon, theory-based definitions of agency and empowerment. Agency is typically defined in terms of one's abilities to set goals and organize one's actions to achieve them (Larson & Angus, 2011). Empowerment refers to beliefs about one's abilities to influence social and political systems (Ozer & Schotland, 2011). However, the constructs of agency and empowerment are sometimes conflated or used interchangeably to describe individuals' perceived sense of control (Krauss et al., 2014). The process of member-checking definitions of agency and empowerment is described in Session 10 below.

The researchers also realized that youth thoughts on empowerment in the OMSI YARB experience (as expressed in research sessions) covered such breadth that it was challenging to use them to articulate particularly important aspects of the YARB. Therefore, to begin articulating some of these variables, the research team looked to the Informal STEM Learning Professional Competency Framework (Morrisey et al., 2020). Select items from these ISL competencies were checked with youth to identify which items were exercised by the YARB, and which items had connections to the constructs of agency or empowerment. This process is described in Sessions 11 and 12 below.

Session 10

Data were collected on July 20, 2022 from four OMSI YARB members in order to member-check common definitions of empowerment and agency. Researchers selected the following definitions that were informed by the literature:

- A. "Empowerment is specific to the sociopolitical domain and refers to beliefs about one's abilities to influence social and political systems. In contrast, agency refers to one's abilities in nonsocial environments" (Krauss et al. 2014, p.1552).
- B. Empowerment is a process by which people, within the systems in their environment, gain understanding and control over their lives and democratic participation in the community (adapted from Rappaport, 1987, as cited in Perkins & Zimmerman, 1995).
- C. Agency is typically defined in terms of one's abilities to set goals and organize one's actions to achieve them (Larson & Angus, 2011).

To member-check these possible definitions of agency and empowerment, the researchers invited youth to participate in an interactive activity. The activity was set up so that large sheets of paper labeled with a consensus/agreement scale (1 - Nope; 2 - I'm not



sure; 3 - I don't have a reason to say "no"; 4 - Good enough; 5 - Yes) were taped in different locations within an outside courtyard, and a paper with definition A was taped to an easel.

The researchers read definition A and asked the youth to quickly go to the number that represented their level of agreement with the definition. Once all of the youth were in place, those that stood next to "nope" or "I'm not sure" were asked, "What about this definition are you unsure about?" The explicit reference to "the sociopolitical domain" did not resonate with the youth, so definition A was removed from the easel and definition B was added. The youth were asked to show their level of agreement with definition B. No youth indicated disagreement (e.g. nope or I'm not sure), affirming the use of definition B in this project and research. The process was repeated with definition C. The youth were asked to show their level of agreement with definition C. No youth indicated disagreement (e.g. nope or I'm not sure), affirming the use of definition C in this project and research.

The youth were then asked to get into pairs and share an example in their lives that they thought was either empowering or supported by agency. After discussing their examples with each other, the youth reported out to the group. A researcher took notes and asked the youth clarifying questions such as, "What do you think makes this agency, rather than empowerment?"

Finally, to provide the youth an opportunity to reflect and connect the concepts of empowerment and agency to the YARB, the youth were asked to write down examples of activities or situations that they participated in as members of the OMSI YARB that allowed them to feel that they had exercised agency or empowerment.

Session 11

Data were collected on July 27, 2022 from four YARB members with the purpose of exploring if the agreed-upon definitions of agency and empowerment were connected to some of the empirically identified ISL professional competencies from the Informal STEM Learning Professional Competencies Framework (Morrissey et al., 2020).

Prior to data collection, three researchers independently identified competencies from the ISL Professional Competencies Framework that seemed important for work related to collective climate action and education and that the youth could have reasonably exercised within the scope of the OMSI YARB. The ISL Professional Competencies Framework has three levels of competencies (with Level 3 being the most advanced level). Researchers agreed upon a total of twelve competencies to include in the activity—six pairs of Level 1 and Level 2 competencies (Table 1). Two pairs of Level 1 and Level 2 competencies were in the category of institutional impact and related to audiences, and equity and diversity. Two pairs of Level 1 and Level 2 competencies were in the category of job-specific expertise and related to effective practice and professional learning. Two



pairs of Level 1 and Level 2 competencies were in the category of general expertise and related to interpersonal knowledge and skills, and communication.

Table 1. Competencies selected from the ISL Professional Competencies Framework (Morrissey, et al., 2020) for use in Session 11.

	Level 1 competencies	Level 2 competencies
Institutional impact		
Audiences	Identify intended and achieved outcomes for my area of work (climate education) that align with an understanding of audiences.	Identify intended and achieved outcomes for my institution (OMSI) that align with an understanding of my community and of the ISL (informal STEM learning) field.
Equity & diversity	Understand and support the characteristics of an equitable and culturally-responsive work environment.	Influence and contribute to equitable and responsive practices within my institution (OMSI) and the ISL (informal STEM learning) field.
Job-specific expertise		
Effective Practice	Provide programs, services, and products that achieve intended outcomes.	Develop or manage programs, services, and products that achieve intended outcomes.
Professional learning	Participate in professional learning that advances my professional and personal goals.	Influence or contribute to professional development opportunities for myself and others.
General expertise		
Interpersonal knowledge & skills	Acknowledge and respect the values, attitudes, and behaviors of myself and of others within my institution.	Support and influence collaborative and mutually-beneficial relationships within my institution (OMSI).
Communication	Demonstrate effective and ethical communication skills in my work (climate education).	Support and influence effective and ethical communication skills with a range of audiences and using a range of media.

Again, researchers used an interactive activity to draw out youth’s perspectives. For the activity, four stations were set up at different tables. Each table had three jars, each jar was covered with a paper sleeve that obscured its contents. In front of each jar was an 8.5x11 sheet of paper with one of the competencies printed on it. Competencies were placed in



random order across the tables and jars. To the left of the leftmost jar on each table was a sheet of paper with the agreed-upon definitions of empowerment and agency and instructions for completing the activity. The youth were asked to indicate whether they perceived each competency to be best associated with the definitions of empowerment, agency, or neither, by dropping a color-coded token in the jar (green for empowerment, orange for agency, and yellow for neither).

Prior to beginning the activity, one of the researchers read aloud the definitions of empowerment and agency agreed upon in Session 10. The youth were then provided with 12 of each color tokens and an individual set of instructions noting that it was a silent activity and each youth would start at a different station and then rotate clockwise when the researchers indicated to do so.

After receiving the instructions, the youth had four rotations, each lasting about five minutes. Once each of the youth had visited each station, the participants' choices were revealed by removing the paper sleeves from the jars. One researcher took notes as the youth explained their reasoning about how the definitions of empowerment and agency could be applied to the competencies from the ISL framework.

Session 12

On August 3, 2022, data were collected from four OMSI YARB members, with the purpose to: 1) member check indicators of competencies that might be exercised by the YARB experience, and 2) member check experiential connections between the indicators of competencies and the constructs of agency and empowerment (*Appendix F*). Data were collected using the Alchemer online survey platform. The questionnaires were completed anonymously within an assigned period of time and took between 10 and 15 minutes. The survey included 2 prompts that asked participants to rate, using a 5-point agreement scale, a total of 13 statements representing the 12 Level 1 competencies selected from the ISL Professional Competencies Framework and used in Session 11, plus one additional competency the researchers agreed was relevant. These 13 statements were drawn from survey items developed as part of the ISL Professional Competencies Framework research (Morrissey et al., 2020).

Coding and analysis

During an initial review of the youth responses about professional competencies and their relationships to empowerment and agency, researchers observed that youth did not have consensus about the relationships between professional competencies, empowerment, and agency, suggesting to the researchers that agency and empowerment were perceived relative to the individual. Based on these initial findings, researchers proceeded with ongoing reading of the literature, reflecting on and integrating data, and keeping individualized and contextualized sense of control in mind. Up to this point, the local YARB



model did not theoretically articulate factors in the OMSI YARB that supported youth empowerment; instead it communicated a conceptual view of how the OMSI YARB fit in a larger societal system.

To determine empowering factors that might be applicable to a model of the YARB, the researchers returned to the literature to identify case studies of empowering organizations. Researchers read about a multiple-case study of empowering community settings (Maton & Salem, 1995) that provided insights into categories of organizational settings that were successful in promoting individual empowerment of its members.

Key characteristics of empowering organizations

Maton and Salem (1995) were supposedly the first among empowerment theory authors to systematize characteristics of empowering community settings. Based on case studies of three different empowering organizations, they developed a set of characteristics that appeared to be common across the settings. This included:

- **Belief System** that is inspiring of growth, strengths-based, and based beyond the self. Referring broadly to a set of principles, values, or culture adopted in an organization, belief systems in an empowering setting define practices “that provide opportunities for member growth and change, as well as ... goals and norms that are capable of motivating, guiding, and sustaining member change efforts” (p. 640).
- **An Opportunity Role Structure** that is pervasive, highly accessible, and multifunctional. This characteristic refers to availability of roles within an organization which provide “meaningful opportunities” for its members “to develop, grow, and participate” (p. 643).

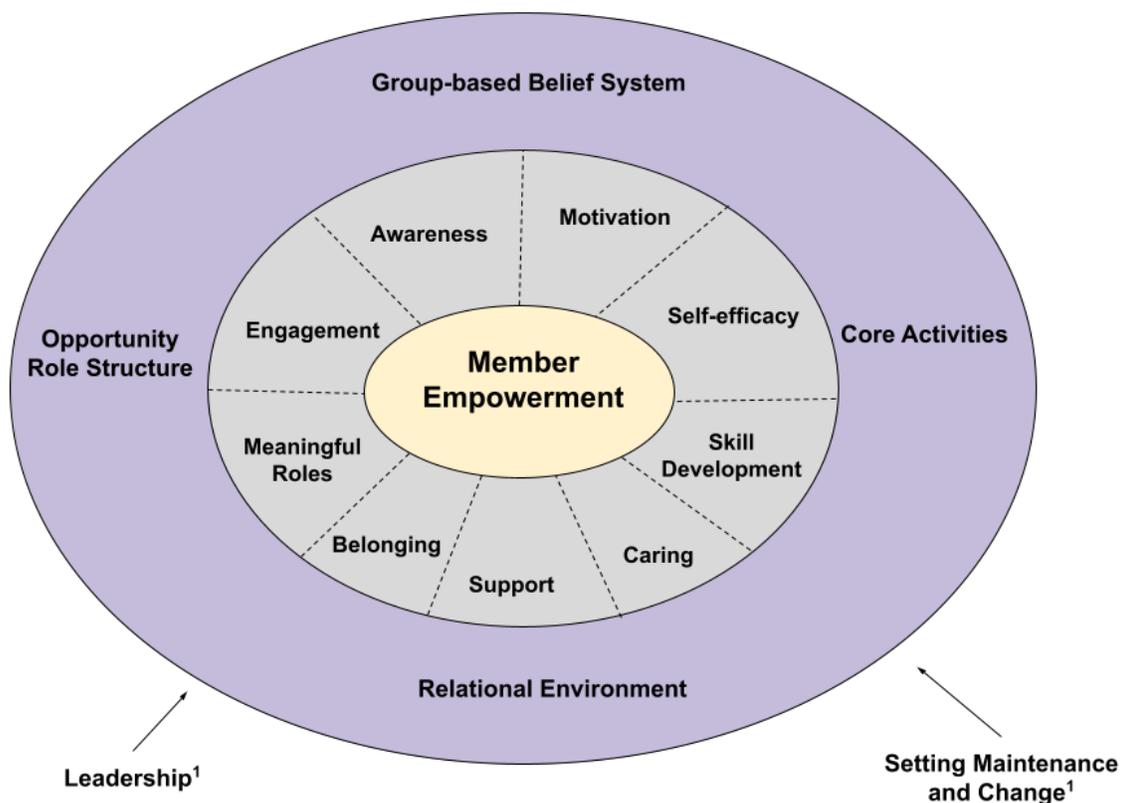
In 2008, Maton further expanded this set of characteristics, including:

- **Core Activities** that are engaging, high quality, and include an active learning process. Core Activities refer to the “basic instrumental techniques used to accomplish the central mission of a setting” (Maton 2008, p. 10).
- **Relational Environment** that encompasses the “quality and nature of interpersonal and intergroup relationships in a setting” (Maton 2008, p. 11) and includes *support system, caring relationships, and sense of community*.

Maton (2008) also introduced the mechanism of member empowerment where organizational characteristics contribute to empowerment over time through associated psychological mediators (see Figure 2). The psychological mediators and their inferred associations with organizational settings were derived from literature on prior research studies.



Thus, according to Maton’s (2008) model, across different types of empowering organizations, group-based belief systems contribute to empowerment in part through the psychological mediators of *awareness* and *motivation*. Core activities support member empowerment through the psychological mediators of *self-efficacy* and *skill development*. Relational environment aids empowerment through the psychological mediators of *caring, support, and belonging*. Opportunity role structures contribute to empowerment through *member engagement* and involvement in *meaningful roles*. Leadership, as well as setting maintenance and change, oversee and serve as major contributors to each of the mediating processes represented in Figure 2. Setting maintenance and change performs this function “by facilitating organizational viability and sustainability,” and leadership does that “through interactions with members” and by “influencing other organizational characteristics” (Maton 2008, pp. 13–14).



¹Leadership and Setting Maintenance and Change are located outside of the oval to indicate that each influences the entire set of organizational characteristics and psychological mediators located within the oval.

Figure 2. Empowering community settings: Organizational characteristics and psychological mediators. Maton 2008, p. 9.

When the aforementioned sets of empowering organizational characteristics and associated psychological mediators are present, an organization has the potential to support its members’ empowerment over time.



Providing language to describe what the youth reported about the OMSI YARB, this literature review helped the researchers realize that they needed to narrow the scope and focus on only one aspect of the YARB (rather than the conceptual view of the societal system)—the youth experience as a member of the OMSI YARB. The empowering settings model provided the appropriate level of granularity to see the relationships between the youth and their environment.

While Maton's (2008) model embodied much of what the researchers were looking for as a theoretical foundation, there were aspects that did not quite match the conceptualization of the YARB model. One such aspect is that Maton's model does not illustrate movement or interaction between the organizational characteristics; for example, it does not account for how Core Activities of *skill development* may impact Relational Environment through *belonging*, how belonging may impact member empowerment, how member empowerment may impact Opportunity Role Structure through engagement, and so forth. However, it was important to the researchers that a visual model of the OMSI YARB was able to convey this movement, as the empowering process is inherently connected across levels (Zimmerman, 2000). Another, perhaps more nuanced, aspect is that Maton situated organizational characteristics of Leadership and Setting Maintenance and Change outside of the influence of the other organizational characteristics; however based on what the researchers had observed in youth data, these characteristics appeared to be embedded within the other setting characteristics.

Researchers realized in order to navigate these areas of misalignment between Maton's model (2008) and the OMSI YARB data, the final iteration of the YARB model would have to adapt concepts from Maton's (2008) empowering community settings, as well as concepts from the current YARB model, and merge them with details that could be empirically captured from research on the OMSI YARB experience.

Of particular interest from Maton's (2008) model were the theoretical organizational characteristics (i.e. Group-based Belief System, Relational Environment, Opportunity Role Structure, and Core Activities). Because youth data suggested that Leadership and Setting Maintenance and Change were embedded within the other setting characteristics, these characteristics were not explicitly labeled within the updated YARB model. Another feature of interest from Maton's model was the positioning of psychological mediators. Because this research project did not employ methods to properly identify mediators, researchers adapted this part of Maton's model by using the term psychological constructs and defining the constructs by adapting language from Maton (2008). To strengthen trustworthiness, OMSI's adapted definitions for all of the psychological constructs were reviewed by three different OMSI researchers. It should be noted that Maton's (2008) psychological mediators of *caring*, *belonging*, and *support* were described as inseparable;



however, the psychological constructs of the OMSI YARB model disambiguated them. OMSI's definitions of these constructs can be found in Table 2.

Protocol for coding artifacts for factors of empowerment

To determine relationships between the youth-reported factors, organizational characteristics, and psychological constructs, a manifest content analysis (Kleinheksel et. al, 2020) was conducted on artifacts from the study in which youth may have discussed their experiences in the OMSI YARB. Data from some of the data collection sessions were not included in this portion of the analysis. For example, data from Session 3 were gathered early in the program, before the youth had an opportunity to have experience as a member of the YARB; while these data were useful for advancing the research, the data did not provide information about the YARB setting. Conversely, some data excluded from this analysis were collected after youth had ample exposure to the YARB setting, such as that from Session 12. However, the nature of the data collected was not conducive to the methods used in this portion of the analysis.

While the YARB was composed of individual youth employed by the science center, the YARB had its own identity and was a group providing expertise to that employer; therefore, we handled the data from the youth in aggregate.

A total of eight artifacts were used in this analysis: four documents with focus group notes (sessions 4 and 5), two focus group transcripts (sessions 7 and 8), and two sets of written responses (sessions 5 and 9).

Researchers reviewed the documents, identifying meaning units (relevant text) related to the organizational characteristics and psychological constructs, and copied them to a google spreadsheet. The meaning units were then reviewed by researchers for emergent themes.

To help ensure integrity of the analysis, two researchers independently coded the emergent themes as being related to one of the four organizational characteristics, Group-based Belief System, Core Activities, Opportunity Role Structure, and Relational Environment. After coding, the researchers met to discuss their codes and resolve any conflicts.

Next, to gain a more nuanced view of the data, researchers used the psychological constructs to code the youth data. OMSI's definitions of these constructs, adapted from Maton (2008) and reflecting the local YARB context, are in Table 2.



Table 2. OMSI's definitions of psychological constructs associated with empowering organizational characteristics within OMSI's YARB, adapted from Maton (2008).

Code	Definition
Awareness	Awareness in the context of the OMSI YARB refers to youth expressions of understanding and how to grow their understanding related to climate impacts.
Belonging	Belonging refers mainly to the sense of community and family-like relational environment within the setting. Shared goals/worldviews, common interest, absence of a single leader etc. contribute to this sense of community.
Caring	Caring encompasses friendly and family-like relationships within the setting; this includes relationships with peers and mentors.
Engagement	Engagement in the context of the OMSI YARB refers to youth expressions of intellectual and emotional involvement with activities because they are meaningful to the member in terms of their personal goals and/or are in agreement with their personality and/or cultural background.
Meaningful Roles	Meaningful Roles in the context of the OMSI YARB refers to youth expressions that they take on new roles and responsibilities, possibly increasing their influence, as their skills and interest increase.
Motivation	Motivation in the context of the OMSI YARB refers to youth expressions of: a) Their [psychological] state of enjoyment, satisfaction, or “flow” in the immediate activity, which is created when they experience challenges that are matched to their skills, and is maintained because the activity is self-rewarding. OR b) An activity that is motivating when they identify with the goals of this activity (even if it's not immediately enjoyable, and the goals are long-term), and these goals are integrated into themselves. Motivation is maintained when the person feels competent and self-determined.
Self-efficacy	Self-efficacy in the context of the OMSI YARB refers to youth expressions of their confidence in their ability to plan and execute a course of action necessary to reach a goal (solve a problem or accomplish a task).
Skill Development	Skill Development in the context of the OMSI YARB refers to competency development because “skill” is too narrow and is so tightly intertwined with other dimensions of educator abilities.
Support	Support broadly refers to resources within the setting [YARB] that contribute to individuals' quality of life and their ability to cope with challenging situations. It includes support from multiple sources—peers, mentors, other OMSI staff—and multiple domains, i.e. practical suggestions and problem-solving support; emotional support (helps enhance self-esteem and/or overcome a stressful situation), and informational support.



To code the data by psychological constructs, the sheet with the meaning units was copied into a coding sheet for each coder. The coding sheets contained three columns: Meaning Unit, Source, and Code. Prior to coding, the coders met to review the coding process and established timelines.

After all of the data were coded independently by both coders, discrepancies in the codes were discussed. Each coder then independently wrote a summary of the findings that included patterns that emerged from the codes, patterns that emerged from the meaning units, inferences made from reviewing the data, implications these patterns had for the YARB model, and excerpts that exemplify each of the codes. The coders and one other researcher reviewed and discussed these summaries for clarification and interpretation.

Approach to analysis of the professional competencies survey

The data collected in Sessions 10 and 11 were primarily in the form of notes and were used to member-check definitions and inform the Session 12 questionnaire. Frequencies from the Session 12 questionnaire data were analyzed to identify the existence of ISL practices supported by the YARB.

Results

This research aimed at creating a local model of the OMSI YARB by identifying the factors of the OMSI YARB that contribute to youth engagement and empowerment in a collective action context. Information gained from both primary and secondary research guided the evolution of the local model throughout this research.

Results of the member checks on empowerment and agency definitions

Research activities sought to ensure agreed-upon, theory-based definitions of empowerment and agency among the youth and researchers. This was accomplished by attempting to reach consensus with the youth on the definitions of empowerment and agency. The youth felt that the sociopolitical aspect of empowerment was too strong in some of the definitions from the literature, with one youth stating, such definitions lack “clarity regarding the fact that empowerment had to do a lot with social systems.” After discussion and reviewing other definitions of empowerment, the youth agreed that empowerment could be defined as “a process by which people, within the systems in their environment, gain understanding and control over their lives and democratic participation in the community” (adapted from Rappaport, 1987, as cited in Perkins & Zimmerman, 1995). Unanimously, the youth agreed with the definition of agency as “one’s abilities to set goals and organize one’s actions to achieve them” (Larson & Angus, 2011).



Results of youth–reported empowerment and agency

When youth were asked to write down examples of activities or situations where they exercised empowerment or agency as OMSI YARB members, their responses for empowerment often mentioned successes, with multiple youth mentioning the “Atlas Fell Art Show” that the youth had organized as one of the YARB climate stories. In regards to agency, the responses tended to involve process, with multiple youth mentioning goal-setting. Table 3 contains examples of YARB activities that the youth identified as activities in which they experienced agency or empowerment.

Table 3. Examples of YARB activities that promote empowerment or agency

Empowerment	Agency
Showing climate art in areas across Portland	Working independently on projects across the Museum.
Successful advisory projects with meaningful agendas	Setting up and completing climate stories by setting goals and making the projects happen
I saw my board game kept people engaged	Remote work time
Getting freedom to choose and build our climate stories	

Results of youth–reported experiences with ISL competencies

Researchers recognized that early drafts of the OMSI YARB model did not sufficiently articulate the practical experience supported by the YARB. They felt that since the youth were serving as ISL professionals, it was important to gain youth perspectives on professional experiences as members of a YARB.

To be as objective as possible, researchers used 12 established professional competencies from the ISL Framework (Morrissey et al., 2020). Youth were asked to identify if they perceived each competency as being related to empowerment, agency, or neither. The data show that while the youth had differing perceptions as to which constructs were associated with each competency, all 12 competencies were identified by at least one youth as associated with empowerment and nine as associated with agency.

The researchers were also interested in understanding if ISL competencies were exercised by members of the YARB. Prior research on the ISL Professional Competencies Framework by Morrissey and team (2020) had identified indicators of the Level 1 competences (but not



Level 2 or 3). Therefore, the OMSI researchers focused on the six Level 1 competencies used in Session 11 and selected two pre-identified indicators for each of them to include in a survey. The researchers also included one indicator of an additional Level 1 competency related to evidence-based practice. These thirteen selected indicators (Table 4) were presented to the youth in an online survey in random order. Each of the 13 indicators had at least one respondent report it was experienced as part of the YARB, and eight indicators had all four respondents report they were experienced as part of the YARB (Table 4).

Table 4. This table lists the 12 indicators associated with the six selected Level 1 ISL professional competencies discussed in Session 11 plus one more indicator for an additional Level 1 professional competency; these indicators were included in a survey of YARB members in Session 12. The indicators with an asterisk were experienced by all youth survey respondents. Those without an asterisk were experienced by at least one youth survey respondent.

	Level 1 competencies	Indicators of competencies
Institutional impact		
Audiences	Identify intended and achieved outcomes for my area of work (climate education) that align with an understanding of audiences.	I can describe the characteristics of the audience my programs or products intend to serve.*
		I identify and support intended outcomes for my programs or products.*
Equity & diversity	Understand and support the characteristics of an equitable and culturally-responsive work environment.	I advocate for and engage in practices that are fair and transparent.*
		I communicate and engage with community groups that share goals or audiences with my area of work.
Job-specific expertise		
Effective Practice	Provide programs, services, and products that achieve intended outcomes.	I receive positive feedback or job performance reviews from colleagues or supervisors.*
		I feel confident in my ability to provide effective programs, services, or products.
Professional learning	Participate in professional learning that advances my professional and personal goals.	I solicit feedback and apply it to my work.*

		I reflect on my professional learning as it relates to my job description and my career goals.
Evidence-based practice	Make decisions about my area of work based on evidence about effectiveness and efficiency.	I question and assess the effectiveness and efficiency of decisions related to my work.*
General expertise		
Interpersonal knowledge & skills	Acknowledge and respect the values, attitudes, and behaviors of myself and of others within my institution.	I recognize and appreciate the values, attitudes, and behavior of others.*
		I avoid defensiveness when giving or receiving feedback.
Communication	Demonstrate effective and ethical communication skills in my work (climate education).	Before I communicate, I consider what I want to say and what the person needs to know.*
		I avoid communication that is potentially harmful to others.

Results of coding data based on constructs in the empowering community settings model

As mentioned previously, the final iteration of the YARB model would be created by merging adapted aspects from Maton’s (2008) empowering community settings model, concepts from the previous draft YARB model, and empirically captured details of the OMSI YARB experience resulting from this coding. Data from the youth suggest that the four organizational characteristics supported YARB member empowerment and the related nine psychological constructs were present during the YARB experience. The following paragraphs highlight some of these characteristics and constructs and how they were represented in the youth data.

The OMSI YARB was focused on keeping youth active and engaged; this was supported by the prevalence of youth responses involving Core Activities or its related psychological constructs. Skill Development was another construct frequently referenced by the youth, with youth indicating that the OMSI YARB provided experience communicating through skills, especially in terms of making concept briefs and understanding that there are multiple people to consider when communicating. Specifically, youth said, “Right now we are getting better at educating people about it [climate change]” and “This program has helped me break down the walls of when and how to talk about climate change.”



Similarly, the Relational Environment was commonly mentioned in youth responses, “The smaller groups working together is helpful with building meaningful relationships.” The construct of Belonging was recurrent in the data with the youth saying that one of the things they found to be empowering was, “Just being together.” Likewise, the construct of Support regularly appeared in the data with youth reporting that “support and encouragement from other people,” helped them feel empowered. While the Caring construct was referenced by the youth, it was done so rarely and in terms of “positive relationships.”

Though infrequently occurring in youth responses, Opportunity Role Structure was present. For example, youth reported that their experience in the OMSI YARB “felt like a 'real' job working with professionals,” Youth responses also indicated the existence of Meaningful Roles though statements such as “Being able to take on a leadership role was helpful in making me feel this way [empowered]” and through Engagement in which youth, “Felt empowered speaking with the public.”

The presence of the Group-based Belief System was commonly seen in youth responses. Often, it was through responses related to Awareness “Interacting those with who have success stories, in areas like policy” and “just understanding the structure and how it works.” Motivation was also present in the data, especially as related to agency “ We also have a lot of creative freedom and flexibility when it comes to our projects.”

Results summary

The data indicate that participation in the OMSI YARB provided youth with the opportunity to exercise skills that are both important for informal science education professionals and identified by the youth as supporting either empowerment or agency.

Generally speaking, the youth believed that the perceptions of others impacted their empowerment, with the idea of youth being “taken more seriously” recurring during discussion. The youth also reported empowerment from Core Activities, specifically, skills such as conducting research and evaluation, communicating formally and informally, and being confident as a climate educator. Activities such as training and developing projects were also seen as empowering. Unsurprisingly, experiencing successes and accomplishing goals were also regarded as empowering. In addition, the youth mentioned the importance of feeling independent and having agency.

Moreover, the factors reported by the youth about their experiences were representative of the organizational characteristics that facilitate member empowerment in Maton’s empowering community settings (2008). These youth-reported factors were merged with concepts of earlier models and adaptations of Maton’s organizational characteristics and associated psychological constructs (Maton, 2008) to create a local model of YARB



member empowerment (Figure 3). In this model, each of the nine outer blocks include factors (e.g. leading project group) and are labeled with the associated organizational characteristics (e.g. Opportunity Role Structure) and psychological construct (e.g. Meaningful Roles). Each block is connected with the center block (which signifies YARB member empowerment) illustrating the influence of the factors and YARB member empowerment on one another.

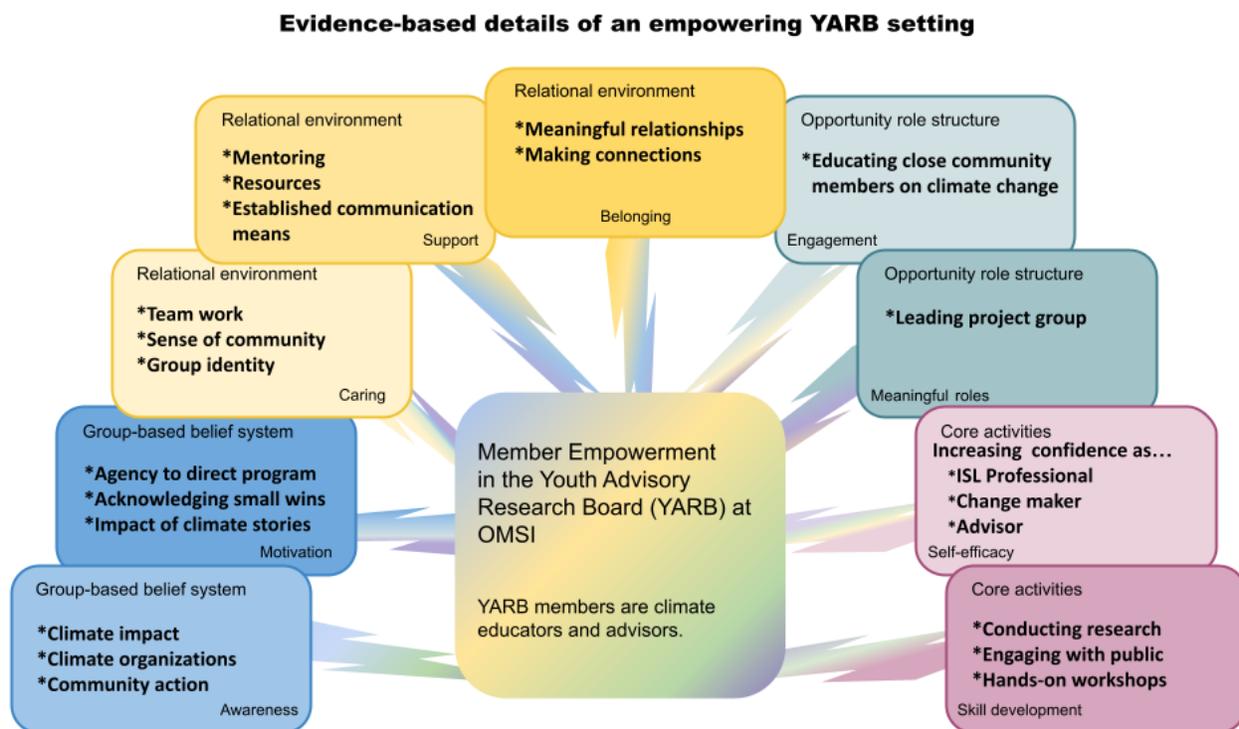


Figure 3. Model of Youth Advisory Research Board (YARB), with evidence-based details of an empowering YARB setting at OMSI (identified by asterisks [*]). Adapted from Maton, K.I. (2008), Empowering Community Settings: Agents of Individual Development, Community Betterment, and Positive Social Change. *American Journal of Community Psychology*, 41: 4–21.

Discussion

The findings suggest that participating in the OMSI YARB had a positive impact on the members' sense of empowerment and agency. The youth data provided examples of OMSI YARB factors that supported member empowerment and were congruent with organizational characteristics of an empowering setting (Maton & Salem, 1995; Maton, 2008). The following paragraphs discuss how these factors were represented in the data and how they provide support for the OMSI YARB psychological constructs and characteristics of an empowering setting.

Factors related to youth engagement

The research team's adoption of empowerment theory (Perkins & Zimmerman, 1995) provided theoretical explanations and framing of the YARB. Far from being merely a theoretical abstraction, concepts of empowerment theory were integrated into the OMSI YARB, with preliminary learnings from the research and evaluation (Herrán et al., 2023) applied to improve upon the ways that the OMSI YARB fostered an environment in which the youth felt empowered to take action and ownership. Later literature reviews uncovered research on empowering community settings (Maton & Salem, 1995; Maton, 2008) that was congruent with other empowerment theory literature (e.g. Perkins & Zimmerman, 1995), but provided a more nuanced theoretical perspective in which to frame the YARB.

Selected because it built on the work of other empowerment theorists and resonated with what the youth had reported, researchers saw that Maton's (2008) theory of empowering community settings could help them better express what had taken place within the OMSI YARB. As discussed earlier, researchers were specifically interested in Maton's theoretical organizational characteristics to better understand broad organizational characteristics of the YARB and the psychological constructs related to Maton's theoretical psychological mediators to provide a more granular understanding.

Within this new framing, it was expected that the psychological constructs related to Relational Environment would have been similarly represented in the data. Caring, specifically, was expected to have been widely represented through the youth having formed friendships and camaraderie. Indeed, youth reported "...we're connected with each other;" however, there was less representation for Caring than anticipated. Caring, along with Belonging and Support, were described by Maton (2008) as inseparable. For this research, these psychological constructs were separated in order to provide a more nuanced view of the YARB factors. Even though Belonging and Support were well represented in the youth responses, the low representation of Caring in the data is likely an indication that work still needs to be done to disentangle the three constructs.

As previously mentioned, the Belonging construct was strongly present in the OMSI YARB, most notably through the high sense of community exhibited by the youth. An expression of belonging occurred early in the OMSI YARB's development in the form of the youth creating a name for their YARB, the *Youth Climate Action Research Educators* (YouthCARE). This identity was further embraced through the development of a YouthCARE logo. This sense of kinship is also evidenced in youth reports of collaboration and belonging as members of the OMSI YARB. Further, it appeared to be manifested during times when the youth reported that they did not feel integrated into the museum—YARB members kept each other motivated and on task to create climate stories, engage with the public, and hold advisory roles.



Likewise, Support was identified by youth as empowering. Youth mentioned both material support, such as resources provided in the museum's Teen Tech Center and transportation passes, as well as programmatic support, such as “having more structured communication” and “more structure in the projects.” This suggests that the youth understood that having agency and being able to make choices does not invalidate the need to approach projects in a planned and organized manner. Overall, the data showed the presence of a Relational Environment and suggests that it did support member empowerment.

With strong findings for Support and Belonging, one might expect Meaningful Roles to have been heavily represented in youth’s responses; it was not. The youth mention leadership multiple times within the data, suggesting that youth were in leadership positions and the YARB provided Opportunity Role Structure. Still, factors related to Meaningful Roles were among the least represented psychological constructs. An explanation for this is that the youth did not associate their work with a particular role, because by “just doing what needed to be done,” roles were not explicitly identified. While the youth may have perceived their work as meaningful, it was not explicitly defined as part of a role, and thus may not have been considered a meaningful role. This explanation is supported by youth discussions that illustrate self-efficacy experienced in the YARB and describe actions that would fall under the role of educator, “...reaching out with the public and teaching.” Similarly, youth stating that “the research also made me feel empowered,” suggests that the youth had a role of researcher. While there is little doubt that Opportunity Role Structure existed in the OMSI YARB and the youth experienced roles that they found meaningful, the low representation of Meaningful Roles in the data indicates that work is still needed to better measure and/or talk about this organizational characteristic and its associated psychological constructs.

Factors related to skill development

The OMSI YARB placed a fair bit of attention on developing core activities, which should be expected from any program, especially one involving youth. Special attention was given to professional skill development because youth were entering an environment that was foreign to them and were sharing their expertise in novel (to them) contexts—advising adults and developing and implementing climate stories. Anecdotally, the youth expressed that there was at times too much focus on skill development; however the data simultaneously revealed that the youth found these skill development opportunities to be useful and empowering with one youth stating, “I think it has led to my personal development in the working world.” The Skill Development construct was the most represented in the data with youth identifying the usefulness of skill development opportunities, both broadly and in terms of specific workshops.



Skill Development includes not only opportunities through formal training, but through practice and on-the-job usage. Because the youth worked as climate impact educators, it was necessary to better understand the opportunities available for YARB members to exercise competencies expected of early career ISL professionals. The theoretical underpinnings of empowerment theory made it important to also see if these competencies were perceived as empowering. The expectation was that there would be consistency among the youth in their perceptions of both the competencies exercised and the competencies' association with empowerment and agency. The reality is that the youth differed in their perceptions of which ISL competencies were empowering, a finding that may be an artifact of the diverse way in which YARB members participated in different activities. Even so, it is evident that each of the competencies measured were perceived by some of the youth to be empowering. That is, while not all youth had reported exercising all measured ISL competencies, all ISL competencies measured were reported to have been part of the work for some of the youth.

The evidence collected in this research suggests that the OMSI YARB provided Core Activities for exercising ISL competencies in situations that leveraged agency (e.g. youth research projects) and empowerment (e.g. advising projects). Some youth reported that the awareness and skills gained were utilized in their everyday lives and enabled them to have difficult conversations around climate change with family members.

Factors related to climate impact education

The data suggest that the YARB had a Group-based Belief System which fostered a belief in the importance of youth agency. Additionally, the youth reported the YARB was a setting that supported members in increasing their awareness related to climate impact, with YARB members saying "I have a better understanding of the world around me." This support in increasing awareness is important not only because it provides youth with a better understanding of the issue, but because awareness allows the youth to better communicate about climate. This communication transcended the walls of the museum supporting an Opportunity Role Structure for the youth to influence the awareness of their close-communities (e.g. family and friends), "...it also made me more mindful on what was going on in the world and led me to influence my family as well." This influence positioned the youth as experts, with youth reporting that "family or friends ask me about things related to climate change," and conversations about climate impact issues, while very serious, were "ultimately more comfortable and focused than they used to be."



Contributions

ISL institutions need to play a larger role in promoting collective action on climate impact, an issue that influences local and global communities. To explore an approach to filling this need, Youth Lead the Way developed and implemented a Youth Advisory Research Board (YARB) model that integrated Youth Advisory Board (YAB) and Youth Participatory Action Research (YPAR) structures. This innovative YARB reflected the youth's lived experiences and provided them with support to exercise skills to advise ISL professionals and create research-informed, public-facing climate impact education products.

Through a YARB, youth and science centers can increase collective action by promoting understanding, professional skills, and connections in sociopolitical ecosystems. By fostering empowerment through a YARB and its connections, it's plausible that a community can strengthen the components and outcomes of a climate action ecosystem. As a core of collective action, this YARB model provides constructs and details that can be applied to connect youth with each other, science center staff, community partners, and members of the public to facilitate evidence-based understanding and collaboration to address climate impacts.

By leveraging constructs from empowerment theory and competencies from the ISL framework, this research created a theory-based local model of the YARB, and identified evidence-based factors that supported youth empowerment (Figure 3) to create innovative climate impact education products, engage the public in activities around climate impact, and advise museum professionals. This local model and its factors can be used to guide other institutions in the development of programming to support youth empowerment to address social issues and develop competencies as ISL professionals.

Findings from this research have already been incorporated into the development of a guide for ISL professionals on supporting a YARB (OMSI, 2023a). Concepts and constructs from this research have also been used in the creation of a professional development workshop (Reilly, 2023). This professional development workshop was piloted at the Sciencenter in Ithaca, New York, a partner organization, to train staff and begin discussing the feasibility of scaling the YARB model in other museums.

Strengths and Limitations

In addition to the utility that the local YARB model itself provides to practitioners, this research provides a foundation upon which other researchers and practitioners can build, expand and explore the intersection of empowerment theory and ISL professional competencies.



Beyond the contributions of the YARB model, this research has added to empowering community settings theory by attempting to disentangle the psychological constructs of Caring, Belonging, and Support. There was enough disambiguation found in this research to suggest that these constructs, though related, are distinct. This separation allows the theory to provide a more nuanced view of an organizational setting and its members, allowing researchers and practitioners to more deeply understand how each psychological construct is related to member empowerment.

It is also important to acknowledge some weaknesses of this research study. First, our evidence comes from a sample of 14 participants at the onset of the project, with only six participants participating at the end of the study—in part due to attrition and in part because the program extended past its original end date. Along with that, the qualitative nature of the data—mostly documenting individual opinions and perspectives—makes it difficult to responsibly make generalizations about the findings outside the specific context of this study.

Lastly, we recognize that our individual biases may have affected how we coded the data. Therefore, we encourage any future research to further explore the potential of YARB as an empowering setting in general, and closely examine the constructs and relationships identified here.

Future Research

This early stage, qualitative research can be used to advance a larger research agenda related to collective climate action. The local OMSI YARB model illustrates relationships between characteristics of organizational settings, empirical factors of the OMSI YARB, psychological constructs, and organization member empowerment that can be further tested as part of foundational research, design and development research, and eventually, scale-up research (Institute of Education Services, 2013). This research agenda could continue to inform empowering settings at science centers while also informing YARB's connectedness in systems of collective climate action. This research can continue to support youth who will be most affected by climate change impacts.

Future studies can strengthen foundational evidence of the theory of empowering settings and models like the OMSI YARB model. For example, Maton (2008) associated the set of “psychological mediators” with the characteristics of empowering settings by making inferences from his review of prior literature. His reports of this research lack definitions and testing of psychological mediators; his construction is fertile territory for exploring and seeking evidence for any of the mediators he identified within a YARB context. While our current study focused the lens on the setting, this type of future research would broaden



the lens to include clear psychological measures of participants. One example we identified in this area is looking at Competency Development in the stead of Skill Development. While this research maintained the term Skill Development as part of the YARB model, it was framed and defined in terms of competency development, because the researchers believed that “skill” is too narrow and is so tightly intertwined with other dimensions of educator abilities, where competencies are more broad and require the effective use of skills, knowledge and behaviors.

Additional research could strengthen foundational evidence of the positions of Organizational Leadership and Setting Maintenance and Change. Both Maton (2008) and adult OMSI staff noted the importance of these constructs throughout the system, yet there is not a clear account of them in Maton’s model or the local OMSI model. For example, in the OMSI model, the term leadership seems to refer to youth leadership; this does not account for areas where the OMSI Youth Lead the Way program was affected by leaders or larger organizational structures (e.g. decision-makers for funding, space allocation, or personnel composition).

Further research can contribute to understanding the theory of empowering settings and YARB models for collective climate action by studying YARBs in a design and development process. For example, in the case of this study of the OMSI YARB, the model emerged from the collective reflections of all involved. Future design and development research can use the OMSI YARB model to create some theories of action to develop a YARB for collective climate action; then through research and evaluation processes, refine the theories of action, the YARB, and the YARB model. This could be done with one site or with multiple sites; at this stage of research, both will have value for helping science centers learn how to be empowering settings for a YARB and collective climate action. Because the OMSI YARB research found that climate action was an important part of the organizational setting characteristic of Belief System, the theories of action can benefit from clearly articulating the collective climate action and impact education vision of the YARB and how this influences results. Additionally, design and development research can explore variables related to YARB adaptability and affordability to prepare for future scale-up research.

Future scale-up research can explore how a YARB fits in with systems of science centers or youth organizations. For example, science centers can be organized and mobilized for additional work in climate action by connecting youth colleagues in YARBs across science centers. Such a large-scale expansion of YARBs could complement the work NNOCCI has done on climate communication (Bales et al., 2015; Geiger et al., 2017) and the work groups like We’re Still In (2017) have done to secure organizational commitments to climate action. Another example of future research could look at how the science center's contributions to empowering settings for collective climate action might benefit existing climate action youth groups in a region. The science center could complement the external youth climate



action groups by supporting them with climate science communication training that can support the development of their climate stories; perhaps the youth organization setting and the science center setting together are the YARB setting.

Overall, this line of research and development is needed to support our continual adaptation to our changing climate and the related innovations and social circumstances. Youth leadership is invaluable and inspiring in this area and while science centers have much to contribute to empowering settings, it is important that science center staff recognize that such contributions still require staff attention to youth, responsiveness to youth, and learning from youth in order to be constructive matches for collective action.

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Appendix A. Questionnaire for OMSI Staff, Session 1

1. Based on the information provided regarding the project and the nature of this questionnaire, do you wish to proceed? * Yes No

2. Thinking about what would make the YARB implementation impactful and meaningful for YARB members, please indicate how important you believe each of the following institutional factors might be for engaged youth.

	Very important (5)	Important (4)	Neutral (3)	Low importance (2)	Not at all important (1)
Access to institutional resources.					
Employment and recognition as paid OMSI staff members.					
Mentorship by and skill sharing with OMSI staff and volunteers.					

3. Additional comments or explanation (optional)

4. Thinking about what would make the YARB implementation impactful and meaningful for YARB members, please indicate how important you believe each of the following training-related factors might be for engaged youth.

Trainings in...	Very important (5)	Important (4)	Neutral (3)	Low importance (2)	Not at all important (1)
science communication					
climate storytelling.					
climate science					
research and evaluation methods					
environmental justice					
multi-cultural connections to climate change					

5. Additional comments or explanation (optional)



6. Thinking about what would make the YARB implementation impactful and meaningful for YARB members, please indicate how important you believe each of the following climate education product development and delivery factors might be for engaged youth.

	Very important (5)	Important (4)	Neutral (3)	Low importance (2)	Not at all important (1)
Youth-led research projects.					
Development of climate education products.					
Public delivery of climate education products.					

7. Additional comments or explanation (optional)

8. Thinking about what would make the YARB implementation impactful and meaningful for YARB members, please indicate how important you believe each of the following collaboration and community related factors might be for engaged youth.

	Very important (5)	Important (4)	Neutral (3)	Low importance (2)	Not at all important (1)
Working collaboratively in a team with peers.					
Developing and conducting community-based research projects.					
Delivering climate education products at OMSI and other community sites.					

9. Additional comments or explanation (optional)

10. If you feel there are additional important YARB implementation model factors we didn't include in the previous lists, please share them with us here.

11. Additional comments or explanation (optional)

12. Please share any thoughts, considerations, questions, or recommendations regarding the YARB factors and/or development of the YARB implementation model.



13. Please share your thoughts regarding what you believe a successful YARB experience would look like, both for youth participants and for OMSI as a whole.
14. Please share any additional thoughts, considerations, questions, or recommendations regarding the overall Youth Lead the Way project.
15. What is your role/affiliation with OMSI?
- a. Employee
 - b. Volunteer
 - c. Teen Science Alliance
 - d. Other (please specify):
16. Would you like to be contacted about future activities related to this project, which may include a request to participate in interviews or focus groups?
- a. Yes
 - b. No
17. Please provide your email address for future correspondence related to this project.



Appendix B. Focus Group Guide for OMSI Staff, Session 2

July 6, 2021

Researcher: _____ Date: _____

Hello, my name is _____ and I am a researcher for the Youth Lead the Way project. Thank you so much for agreeing to participate in our focus group!

Reminder of participant's rights (participation is voluntary, participants have the right to stop anytime and not answer all questions) and purpose of the interviews.

Ask if we can record.

[Explain YLTW and YARB]

As a follow-up to the questionnaire you completed, we want to know more about your thoughts and ideas related to some initial YARB model design factors. Answering our questions is voluntary and you can stop anytime. If you decline or stop, that will have no influence on your relationship with OMSI.

This focus group shouldn't take longer than 90 minutes. We want to get to know you all a little, and also hear some of your thoughts and ideas around 1) the initial list of YARB model design factors, 2) the additional factors that were suggested from the questionnaire, and 3) any new or additional ideas related to our full list of factors or the overall YARB model and YLTW project.

1. Let's start with an icebreaker. Can you tell me your name, your relationship with OMSI, and your favorite ecosystem to spend time in?
2. How would you describe the YARB? What do you think will be some of the most significant outcomes from the YARB? What challenges do you foresee?
3. Let's talk about the YARB model design factors. Which of the factors identified from the questionnaire do you think will be the most beneficial to the YARB members? Which of the factors do you think will have the biggest impact on outcomes of the project (like the YARB members' research processes and developed climate education products)?
4. Ok, let's think about the overall YARB model. Are there any design factors that seem to be missing at this point in the project's development? What might those be and how do you think they will be important?
5. Any final thoughts, comments, or questions regarding the YARB, the YARB model design factors, or the broader YLTW project?

Thank you so much for your collaboration!



Appendix C. Focus Group 1 Guide for YARB Members, Session 3

July 9, 2021

Thank you so much for agreeing to participate in our focus group!

A big, big part of Youth Lead the Way is the Youth Advisory Research Board, or YARB. For our research, we want to create a model that can be applied in other museums and maybe on other topics. To do that, we'll need to identify the factors of the model that contribute to our desired outcomes of *youth engagement*, *climate impact education*, and *Informal Science Education Professional Development*. In this hour, we want to talk about *youth engagement* and see what factors support it so we can use that information for our model.

Below are four questions we will discuss.

1. What themes or topics make you feel really passionate or engaged for a long period of time, more than anything else you've been doing? (climate change, social justice, inequality, art, a hobby, something you like learning about, etc.)

[If you are thinking about an activity rather than a theme, like 'playing video games' or 'playing basketball', think about what about the activity makes you feel passionate. Is it the community? Maybe a feeling of satisfaction, or of accomplishment?

2. When you think about these, what do you think supported your passion? What kept you engaged for a long period of time? (for example, having the right information, mentorship, collective interest, interesting ways to engage, the feeling that you can do something about it)
3. Thinking about the opposite, describe a time you felt engaged about something for some time but then got discouraged. If so, what happened?
4. What are some resources that a museum can use to support your interests?

How can an institution make you feel heard and respected? (prompt: What about the YARB, how can it support your engagement and be successful?)



Appendix D. Focus Group 2 Guide for YARB Members, Session 4

July 30, 2021

Researcher: _____ Date: _____

Thank you so much for agreeing to participate in our focus group!

We want to know more about your experience as a member of the YARB thus far, and specifically your thoughts and ideas related to some aspects of the YARB model and program. Answering my questions is voluntary and you can stop anytime. If you decline or stop, that will have no influence on your relationship with OMS.

This focus group shouldn't take longer than 60 minutes. I want to get to know you a little and some of your thoughts and ideas around 1) your experience as a member of the YARB, 2) your thoughts on some of the specific aspects related to the YARB, and 3) any new or additional ideas related aspects of the YARB that have not been mentioned.

1. First, can you describe how your experience as a member of the YARB has been so far?
2. What aspects of the YARB experience have been most beneficial or rewarding to you?
3. Which of the aspects of the YARB do you think have the biggest impact on outcomes of the project (like your research processes and developed climate education products)?
4. What are some ideas about ways to improve future YARB programs?
5. Any final thoughts, comments, or questions regarding the YARB and/or your experiences?

Thank you so much for your collaboration!



Appendix E. Group Discussion Guide for YARB Members, Session 9

May 8, 2022

1. Tell us about something that you were struggling with in YouthCARE.
 - a. What was it, and what happened? Did it get resolved?
 - b. Tell us about something that went particularly well. What was it?
2. How was your experience with YouthCARE programming?
 - a. Tell us about something that you were struggling with with the programming (contents, scheduling, breaks...).
 - i. What was it, and what happened? Did it get resolved?
 - ii. Tell us about something that went particularly well. What was it?
3. How was your experience with YouthCARE advising (both advising projects)?
 - a. Tell us about something that you were struggling with when you were advising OMSI. What was it, and what happened? Did it get resolved?
 - b. Tell us about something that went particularly well, if there was anything. What was it? How was your experience with YouthCARE research and climate stories?
4. Tell us about something that you were struggling with when you were researching, creating, and evaluating your climate stories. What was it, and what happened? Did it get resolved?
 - a. Tell us about something that went particularly well. What was it?
5. How much do you think you were able to reach communities?
6. Do you have any thoughts on reaching communities you would like to share with us?



Appendix F. Questionnaire for YARB Members, Session 12

August 3, 2022

Thank you so much for agreeing to fill out this questionnaire.

As a member of YouthCARE, please provide your thoughts to contribute to the research-based model of this youth advisory research board.

There are no right or wrong answers—you may honestly share your thoughts and perceptions.

This questionnaire will likely take 15 - 20 minutes of your time.

YARB Experience

1) Thinking about your experience in YouthCARE, please let us know how much you agree with the following statements

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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- I feel confident in my ability to provide effective programs, services, or products.
- I receive positive feedback or job performance reviews from colleagues or supervisors.
- I reflect on my professional learning as it relates to my job description and my career goals.
- I solicit feedback and apply it to my work.
- I recognize and appreciate the values, attitudes, and behavior of others.
- I avoid defensiveness when giving or receiving feedback.
- I question and assess the effectiveness and efficiency of decisions related to my work.

2) Still thinking about your experience in YouthCARE, please let us know how much you agree with the following statements

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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- Before I communicate, I consider what I want to say and what the person needs to know.
- I avoid communication that is potentially harmful to others.
- I can describe the characteristics of the audience my programs or products intend to serve.
- I identify and support intended outcomes for my programs or products.
- I communicate and engage with community groups that share goals or audiences with my area of work.
- I advocate for and engage in practices that are fair and transparent.
- I often ask "Why?" or "What evidence supports that approach?"



Follow-Up

Definitions

Agency is typically defined in terms of one's abilities to set goals and organize one's actions to achieve them (Larson & Angus, 2011).

Empowerment is a process by which people gain understanding and control over their lives within the systems in their environment, democratic participation in the life of their community (Rappaport, 1987).

Based on the definitions of empowerment and agency discussed in earlier sessions (above), please indicate if you think the following statements more reflect empowerment, more reflect agency, or reflect neither empowerment nor agency.

For each statement in Q1 and Q2 with a response of "Agree" or "Strongly agree", ask the participant to "indicate if you think <statement> more reflects empowerment, more reflects agency, or reflects neither empowerment nor agency."

- > If the participant responds with "Neither," ask, "Please tell us more about why you believe <statement> reflects neither empowerment nor agency."**

Thank you for all your contributions to the YLTW research. Thank you for completing this questionnaire. Your responses are valued.

