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Summative Case Study

The Science Museum of Virginia and Groundwork RVA's Community Science Partnership

PREPARED BY
Kera Collective

FOR
The Science Museum of Virginia

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Summative Case Study: The Science Museum of Virginia and Groundwork RVA's Community Science Partnership

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01 Case Study Background

About the Case Study

The Science Museum of Virginia contracted Kera Collective to conduct two rounds of formative evaluation and a summative evaluation of its community science project RVAir funded by the Institute of Museum and Library Sciences (IMLS). In 2021, Kera Collective completed a formative evaluation. In 2022, Kera Collective conducted a case study to explore the partnership between the Science Museum and Groundwork RVA over time. Case studies provide rich detail and a nuanced understanding of individuals' experiences with both the Science Museum and the air quality community science program.

The following case study details the trajectory of the Science Museum and Groundwork RVA's partnership and examines findings from the culmination of their community science partnership: RVAir, the Science Museum's community science project centered on studying air quality in Richmond neighborhoods.

Case Study Objectives

The case study explores:

- Motivations for developing a community science partnership (Groundworks RVA and Science Museum staff) and motivations for participating in community science (Groundworks teens)
- How the relationship between Groundwork RVA and the Science Museum has changed over time (considering the pandemic and other factors)
- Successes and challenges of relationship-building between these organizations
- Opportunities to strengthen this community science partnership in the future and support the Science Museum's strategic goals to:
    - "Cultivate partnerships that will inform Science Museum content to ensure its programming reflects, respects, and addresses the needs of the communities it serves" (Strategic Goal 2)
    - Ways the Science Museum's community partnerships can empower participants with "information, skills, and resources that spur both individual and collective action that leads to positive change" (Strategic Goal 3)

Methodology

From July to August 2022, Kera Collective conducted case study interviews with Groundwork RVA staff and collaborators (5 interviews), Science Museum staff who have worked closely with Groundwork RVA (5 interviews), and Groundwork RVA teens who participated in the Science Museum's air quality community science activities during the IMLS grant period (3 interviews).

All interviews were conducted via telephone or Zoom.[1] Kera Collective secured parent/guardian permission before conducting interviews with teen participants. Groundwork RVA teens received a $10 honorarium for their participation. Kera Collective researchers typed notes during the interviews to capture responses as close to verbatim as possible.

[1] Copies of the interview guides are included in the Appendix.

02 Key Takeaways

Overall Takeaways and Discussion

The partnership between the Science Museum and Groundwork RVA is highly successful and demonstrates a reciprocal relationship that has grown over time. Interviews with staff from both organizations indicate the importance of aligned missions, strong communication, and intentional collaboration in creating an effective, long-lasting community science partnership. RVAir, the culmination of the Science Museum's and Groundwork RVA's partnership, was ultimately successful in working toward RVAir's desired outcomes. Despite the challenges of the pandemic, RVAir teen participants were able to collect data, understand climate inequities, apply science to their daily lives, and practice key science and social skills.

01

The partnership between the Science Museum of Virginia and Groundwork RVA developed over time based on shared missions and trust.

In interviews with Groundwork RVA and Science Museum staff, participants described strong alignment between their organizations' missions and goals, which ultimately provided a foundation for their partnership to grow. These organizations' shared interests in green spaces, sustainability, and community impact created a natural opportunity for partnership. Over time, as these organizations began to work together, they built a trusting relationship through clear communication, flexibility to adapt to each other's needs, and sharing resources (funding, space, time, and networks) generously. Shared goals, time, and trust are essential ingredients for building a successful partnership that lasts. Through their actions, both Groundwork RVA and the Science Museum demonstrated they were committed to cultivating a partnership that would be meaningful and beneficial to each other, their missions, and the Richmond community.

With the IMLS-funded RVAir project, the Science Museum and Groundwork RVA's partnership has continued to evolve into a more intentional, collaborative model of partnership (e.g., the Science Museum incorporated Groundwork RVA earlier in the project development process and structured grant funding to better support their partner). Significantly, the Science Museum is applying lessons learned through the Groundwork RVA partnership to its other community partnerships.

02

The Science Museum of Virginia and Groundwork RVA's RVAir community science program makes science and climate inequities tangible for teen participants.

Both staff and teens said that through hands-on data collection on air quality walks, teens were able to see their own community through a scientific lens. Using mobile air quality sensors, teens participated in collecting air quality data; they were able to immediately record and visualize their collected data. Significantly, collecting data in their own communities provided a concrete reference point for understanding the implications of scientific data in their own lives—for example how and why poor air quality existed near a restaurant they frequent. Notably, RVAir not only provided data collection experience for teen community scientists, but also supported youth-directed community projects in the museum's makerspace, The Forge. Staff believe, and we agree, that projects in The Forge can help youth see a "greater purpose" for science as a tool to improve their communities.

As the museum continues RVAir and other community science programs, opportunities abound to strengthen intersections between data collection, interpretation, and actionable community solutions in the Forge. Finding intentional throughlines that connect science to action and hyperlocal data will move the museum toward its goal of empowering participants with "information, skills, and resources that spur both individual and collective action that leads to positive change" (Strategic Plan Goal 3).[2]

[2] Science Museum of Virginia Strategic Plan 2021-2026, p. 17. https://smv.org/documents/227/Strategic_Plan_2021_-_2026.pdf

03

RVAir programming offered teen participants an important mix of both skill-building and social opportunities.

The Science Museum articulated several intended outcomes for Groundwork RVA's teen participants in RVAir, related to understanding the importance of air quality data, confidence in interpreting data, and using science to inform individual and collective action. The formative evaluation results and interviews with staff and teens conducted for this summative case study suggest RVAir is successfully working toward these outcomes. A perhaps unexpected outcome for teen participants in RVAir, which began as the Covid pandemic unfolded, was making social connections with peers with shared interests during a time when many were feeling isolated. The program balanced place-based scientific learning, skill building sessions, and what teens perceived as social opportunities, such as collecting data with friends and meeting new people.

Even as the pandemic retreats, we believe the social element of RVAir will remain important to teen participants and is essential to helping youth "see themselves in STEM," particularly those who have not visited or frequented the museum in the past.[3] Creating an experience that is welcoming, accessible, and social will help participants feel like they are being invited to be part of a community. Moreover, continuing to partner with organizations like Groundwork RVA, which have established, trusted relationships with teen participants, will be vital for creating programming where teens feel comfortable engaging with museum resources.

Teens have many priorities competing for their time, and feeling connected to a community of peers may help encourage them to prioritize community science experiences with the museum (increasing participation, which was one challenge for RVAir) while also deepening their engagement with science.

[3] Science Museum of Virginia Strategic Plan 2021-2026, p. 7.

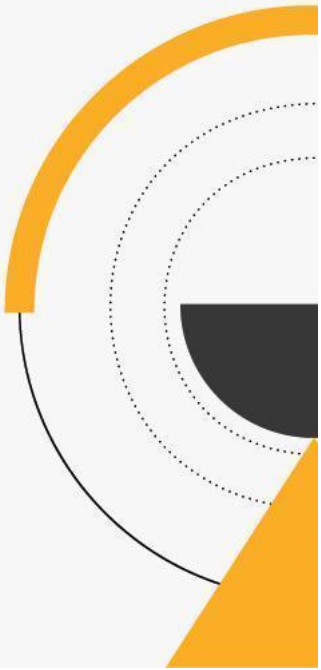
04

There are several key opportunities to increase the accessibility of RVAir for teen participants in the future.

The Science Museum and Groundwork worked together to find ways to make RVAir participation as easy as possible for participants, for example by meeting at a community center convenient to teen's neighborhoods rather than the museum for air quality walks, adjusting hours at The Forge to accommodate afterschool programming, and aligning RVAir activities with Groundwork RVA's existing schedules. However, staff still struggled with securing consistent participation from teens—a common problem with afterschool programming and likely exacerbated by the pandemic. Two recurring suggestions from staff were to offer paid opportunities (e.g., stipends) for teens and to offer transportation.

When deciding how to spend their time outside of school, teens often weigh participating in extracurricular activities with taking a paid job. Offering compensation to teen participants opens up this experience to more teens, incentivizes more consistent participation, and also demonstrates to teens the value of their contributions to the program and their communities. Transportation is another potential barrier to participation. Staff suggested allocating funding that supports transportation in future projects to make participation convenient and affordable for teens.

03 Staff Interviews



Overview

From July to August 2022, Kera Collective conducted five virtual interviews with Science Museum staff and five virtual interviews with Groundwork RVA staff. Interviewees at the Science Museum include the Director, Chief Scientist, Community Science Catalyst, Director of Maker Education, and Deputy Director of Education. Interviewees at Groundwork RVA include former staff members (former Director, Green Team Manager, and Youth Program Manager) and current staff (Youth Program Manager and Development and Communications Manager).

History of the Partnership

Participants were asked about their involvement in the partnership between the Science Museum and Groundwork RVA. In their responses, participants discussed the origins of the partnership. A narrative of the partnership's history emerged from the conversations and is outlined below.

Early Stages

In 2017, the partnership between the Science Museum of Virginia and Groundwork RVA began with informal relationships—it grew out of a people-centered approach, sparked by informal conversations between staff at both organizations. For example, the Science Museum's Chief Scientist met the Groundwork RVA's former Executive Director through a mutual friend; also, Groundwork RVA's former Green Team manager used to work at the Science Museum.

As described by staff at both organizations, through informal discussions, Science Museum and Groundwork RVA staff worked to find organic connections between Groundwork RVA's focus on green space and the Science Museum's focus on climate. Significantly, both organizations saw the potential in community science. A community science approach could serve as a way for the Science Museum to engage Virginia residents in science and further live out their mission to be a "community-focused institution driven to change the way Virginians see the world."[4] For Groundwork RVA, a community science approach could help demonstrate how their work in youth leadership, conservation, and recreation exemplified climate action and their teen urban conservationists "making Richmond greener, more sustainable and more equitable."[5]

Urban Heat Island Study

Some participants said the Urban Heat Island study signified a step forward for the partnership between Groundwork RVA and the Science Museum. During an extreme heat wave in 2017, the Science Museum collaborated with local university students, faculty, and Groundwork RVA's Green Team (youth urban conservationists) to study correlations between extreme temperatures and heat-related illnesses in local areas, especially in formerly redlined Richmond neighborhoods and communities facing economic

[4] https://smv.org/documents/227/Strategic_Plan_2021_-_2026.pdf
[5] https://www.groundworkrva.org/mission

barriers.[6] The Science Museum and Groundwork RVA saw an important opportunity to fill significant gaps in research by collecting hyperlocal data; both organizations could better understanding heat vulnerability in Richmond and work toward mitigating health risks and concerns in the city.

Participants also said the community science partnership between the Science Museum and Groundwork RVA for the Urban Heat Island study was invaluable. Groundwork RVA is committed to environmental justice. As an organization, they "realize racial equity and promote social justice" by working with teens in Richmond to "facilitate environmental, economic, and social well-being in neighborhoods."[7] The Urban Heat Island Study aligned with Groundwork's principles of racial equity – a network of Groundwork RVA teens, Groundwork RVA staff, and Science Museum educators and scientists worked together to gather temperature data in the very neighborhoods that many of the Groundworks teens lived in. They analyzed and mapped temperature variations in locations across Richmond and devised neighborhood-specific solutions and community sustainability plans for decreasing urban heat effects. At the same time, this community science collaboration aligned with the Science Museum's goals around promoting applied learning, highlighting environmental science, and improving well-being for Richmond residents. This model of community science collective leadership, due to its success, was also implemented in Baltimore, MD and Washington, D.C.

Continued Collaboration

After the Urban Heat Island study, participants said their partnership continued with collaboration on grant proposals and projects such as *Throwing Shade in RVA*. With this highly collaborative program, Groundwork RVA teens learned more about the urban heat island effect, analyzing its impact on Richmond and visioning possible solutions. To tangibly grow their partnership, the Science Museum and Groundwork RVA started with small grants and one-off programs. As their partnership strengthened, they were able to apply for larger grants and funding, expanding their implementation. Collaborative projects between both organizations included, but was not limited to, the following:

- **Visits to the Science Museum's Forge (a makerspace)**: For example, for one collaborative project, Groundwork RVA teens used specialized equipment available at the Forge to create engaging designs for trash can lids. Such creative, fun trash can lid designs sought to encourage residents to recycle and reduce litter—their work won an award for innovation. Teens also used tools in the Forge to make signs for projects at Groundwork RVA.
- **A hydroponic system in Highland Park:** The Science Museum collaborated with Groundwork RVA teens to create a hydroponic system for a local community center where youth can access "innovative programming in advocacy, art, green construction, education, career success. history and healing."[8]

[6] As described by Cornell Law School, redlining is a "discriminatory practice that consists of the systematic denial of services such as mortgages, insurance loans, and other financial services to residents of certain areas, based on their race or ethnicity."

[7] https://www.groundworkrva.org/mission

[8] https://www.6picrva.org/

- **Shared promotion of projects**: The Science Museum promoted Groundwork RVA's upcoming projects centered on urban beautification and green spaces.

RVAir

Years of collaboration led to RVAir, a community science project studying air quality in Richmond neighborhoods. RVAir, like the Urban Heat Island project, was a community science project that addressed a community-focused topic: air quality. Historically, the city of Richmond has had poor air quality, affecting residents across the city. In 2014, Richmond was deemed the "Sneeziest and Wheeziest" city in the US by the National Resources Defense Council. On the National Asthma and Allergy Foundation's list, Richmond is the "second worst US city for Asthma sufferers." Air quality issues intersect with racial and social inequality; residents of historically underserved Richmond communities are on the frontlines of climate change threats facing Richmond. Thus, as participants said, RVAir signified another commitment to community science because it used community collaboration, data collection, and information sharing to help groups make more informed decisions and place "control back in the hands of the people most affected by [environmental] challenges."

In 2020, the Science Museum launched RVAir. As the project's formative evaluation revealed, RVAir was highly effective in "creating enjoyable, safe opportunities for participants to have a positive impact on their communities by collecting local air quality data."[9] As a Groundwork RVA staff member said, the Science Museum's Chief Scientist and Community Science Catalyst were flexible and resourceful collaborators and built relationships across the city that benefited the project. In addition to collaborating with Groundwork RVA, the Science Museum partnered with community partners to collect over 500 air quality datasets across the City of Richmond.

However, aspects of RVAir's collaboration with Groundwork RVA had to be adapted due to the pandemic, including reducing group size for data collection walks and shifting data interpretation workshops to Year 3 of the project. With a smaller number of recruited teen participants, data collection areas also had to be adjusted. As one Groundwork RVA member said, they initially planned to collect more air quality data in Hillside and Southside Richmond and had hoped to visit Southside schools, providing classroom demonstrations and recruiting teens for air quality walks. Yet, when school shifted to online learning, it was difficult to reach schools and thus recruit new teen participants. Lastly, Groundwork RVA also had significant staffing changes, which kept the project from being as active as originally envisioned.

However, during the pandemic, the Science Museum stayed connected with Groundwork RVA. With guidance from the Science Museum's Community Science Catalyst, Groundwork RVA teens learned how to collect air quality data in the Northside region of Richmond. Additionally, teens visited the Science Museum's Forge to craft signage for their community garden, and the Science Museum acquired funding to provide a shed to house Groundwork RVA's air quality supplies and tools that will support native plantings and mitigation efforts to address local urban heat island effects and air quality measures.

[9] Kera Collective. (2021). RVAir Program, Year 1: Formative Evaluation. Unpublished report. Richmond, VA: Science Museum of Virginia.

Partnership Motivations and Goals

Both Science Museum and Groundwork RVA staff were asked what motivated their organizations to develop a community science partnership and goals for the partnership. Most interviewees discussed how community science embodied a collaborative approach for involving community members in environmental equity and scientific research. Responding to positive feedback from the Urban Heat Island study, both organizations were excited by future opportunities, such as RVAir, to involve Richmond audiences in exploring questions relevant to communities such as air quality.

Reflecting on their community science partnership, interviewees mainly cited three main motivations or goals for the partnership: (1) alignment of missions; (2) engaging with local, youth communities; and (3) sharing resources and networks. Lastly, a few Science Museum staff members discussed how their partnership goals evolved over time, especially during the pandemic.

Alignment of Missions

Quite expectedly, alignment of missions was the most significant motivating factor for the Science Museum and Groundwork RVA. Each organization is committed to engaging youth audiences in environmental science and improving quality of life for Richmond community members. The Science Museum continually aims to support environmental stewardship, become a more thoughtful resource for community science, and include youth "in the discovery of new things." Similarly, Groundwork RVA is dedicated to cultivating and supporting the next generation of environmental leaders. They want youth audiences to "feel equipped to lead, [and] feel heard and centered" because their main goal, as an organization, is to help youth "become community leaders and activists [so that], in twenty years, they are breathing cleaner and cooler air." These shared missions and goals, as one Groundwork RVA staff member said, allowed for a "very organic connection between engaging youth and community science."

Furthermore, by participating in community science and gathering data, the Science Museum and Groundwork RVA could leverage their joint resources to raise awareness of environmental issues and provide evidence supporting the importance of their environmental work. For example, a few Groundwork RVA staff members discussed how their partnership with the Science Museum highlighted the ways their work (building green spaces and infrastructure) was directly connected to climate science.

> *"In Virginia, it was becoming evident [that] heat and air quality [were] pressing issues for environmental human spaces and we needed to focus on these spaces. Youth were in these vulnerable communities…[so it] became an easy connection. It's all interconnected. [We] focus on people and how the environment impacts them long-term. For us, [it's about] how communities are hurt and helped. How we can step into spaces and be a champion for folks who don't have the time and info. And pay youth." –Former Groundwork RVA staff*

Connecting with Local Audiences

A few Science Museum staff members said the museum's partnership with Groundwork RVA mirrored their institution's goals for community engagement and outreach. In particular, one Science Museum staff member said the museum sought to strengthen relationships with communities of color in Richmond. Therefore, Groundwork RVA's goal of racial equity and established presence in communities of color made them an ideal partner. Another Science Museum staff member discussed the museum's commitment to engaging teen audiences, and in particular working toward making the Science Museum a safe and rewarding space for young audiences unfamiliar with the museum or who do not feel comfortable visiting. Community science offers another way for museum staff to interact with multiple audiences, as one Science Museum staff described. Community science also underlines an important goal of outreach: connecting community members' lived experiences and community-driven issues with science topics.

The partnership between Groundwork RVA and the Science Museum also provided skill-building opportunities for teen leaders. Groundwork RVA staff members said, by engaging in community science, they also hoped to introduce their youth audiences to different science topics, getting them more comfortable with science. Additionally, community science offered an opportunity for long-term engagement with teen audiences (instead of one-off programs).

Sharing Resources and Networks

Some participants mentioned the benefits of sharing resources and networks—they were able to support each other. For example, as Science Museum staff members said, Groundwork RVA had an established, deep connection to youth audiences in historically underserved Richmond communities. In addition to their large presence in Richmond neighborhoods, they brought a legacy of equity and environmental action to the partnership. At the same time, as Groundwork staff members pointed out, Groundwork RVA teens could use the Science Museum's Forge (a makerspace) in their projects and benefit from learning from the scientists on staff.

Evolving Goals

A few participants discussed how goals evolved throughout their partnership. For example, one Groundwork RVA staff member recalled how their collaboration began with the goal of finding evidence for environmental issues in redlined neighborhoods. After collecting and analyzing data, their goals shifted toward implementing change in Richmond's master planning (such as advocating for climate solutions and more parks and green spaces).

A Science Museum staff member also emphasized the importance of flexible goals in strengthening their collaborative efforts. Due to the pandemic, their goals for RVAir shifted. Originally, they sought to work with students to find avenues for advocacy or ways to mitigate air pollution. When the pandemic hit, an additional goal arose: "learning how to be a flexible community partner," and "reestablishing relationships" with Groundwork RVA staff, especially when programming had to be paused or changed.

Partnership Strengths

Participants were asked about the partnership's successes in implementing RVAir. They identified several strengths in the partnership between the Science Museum and Groundwork RVA.

Open, Strong Communication

Several praised the direct and responsive communication between organizations. Due to Groundwork RVA's regular, structured schedule, Science Museum staff could plan in advance and find exact openings for visits. At the same time, Groundwork RVA staff praised the Science Museum for being flexible and accommodating; the museum coordinated visits and walks around Groundwork RVA's existing programming. Lastly, as one Science Museum staff member said, it helped tremendously that both the museum and Groundwork were patient and responsive when timelines shifted due to the pandemic.

Welcoming Spaces

Groundwork RVA staff members appreciated the Science Museum's deliberate effort to make teen participants feel comfortable. For example, a Groundwork RVA staff member appreciated that a community center conveniently located in the teen's neighborhood was set up as a regular, meeting place for teens before they participated in RVAir or visited the Science Museum—teens could fit a trip there into their afterschool routine.

Additionally, another Groundwork RVA staff member said that the Science Museum helped create a welcoming environment for their museum visits. Museum staff were great partners because they were very accommodating and listened to Groundwork RVA's needs. Groundwork RVA teens grew to feel comfortable working at the Forge and exploring the Science Museum. The Science Museum's Forge stayed open later for Groundwork RVA visits, and even after the museum closed, the museum's security guards did not question their presence there or make them feel awkward. In fact, as one Groundwork staff member said, there was a sense that "you [could] interact with space how you need and want to."

Resources

Both Science Museum and Groundwork RVA staff discussed how resources (materials, space, funding) positively impacted RVAir. For example, RVAir participants only needed a tablet and mobile sensor. This material-light approach made it easier for participants to keep track of equipment and for Science Museum staff to quickly set up data collection walks. Moreover, in July 2020, the mobile sensor interface was updated, providing a more streamlined design, clearer instructions, and instant visualization of collected data. Thus, participants could immediately view and discuss the results of their walkabouts. Groundwork RVA staff also valued other resources the Science Museum was able to provide, such as designated space for Groundwork activities (such as the Forge), free admission to the museum, and funding (which Groundwork RVA could use at their discretion).

Openness to New Ideas and Collaborations

Both Groundwork RVA and the Science Museum appreciated each other's openness to explore new methods of collaboration and science. For example, the Science Museum and Groundwork RVA were open to youth-directed ideas; while there were programming agendas and goals, teens could still follow their own interests. As the Director of Maker Education explained, Science Museum staff did not want to dictate ideas to teens—instead, staff would introduce a topic and facilitate conversations with teens to get their input and ideas for possible projects.

Partnership Challenges

Participants were asked about challenges the partnership faced in collaborating to implement RVAir. A few participants said there were no challenges, or they were unfamiliar with any challenges during RVAir. The remainder of staff at both organizations discussed a few challenges that impacted RVAir. Overall, the pandemic significantly affected RVAir's implementation and changed its timeline.

Post-Pandemic Challenges

Expectedly, the pandemic added delays to the project. Mainly, the Science Museum and Groundwork RVA staff had to work around covid-impacted schedules and learn to balance expectation and implementation (what was originally planned vs. what was possible). Due to the pandemic, the Science Museum and Groundwork RVA had to:

- **Adjust schedules**: Groundwork RVA's Green Team schedule shifted—some sessions had to be shortened while other sessions were booked far in advance. Schedule changes meant that the Science Museum was unable to have more consistent meetings with Groundwork RVA teens.
- **Re-envision data collection walks**: In order to have covid-safe works, walking groups had to be smaller in number.
- **Handle equipment delays**: Due to supply chain demands, data collection equipment was delayed, and staff had limited tablets and sensors to work with.

Staff Assistance

Participants from both organizations pointed out the need for more staff or assistance to support RVAir. Currently, the Science Museum's Community Science Catalyst runs RVAir, which is a significant undertaking for one person—more staff support, such as an intern or a staff member, would help the Community Science Catalyst manage responsibilities such as coordinating the program, conducting outreach, leading sessions.

Unpredictable Attendance

One Science Museum staff member said it was sometimes difficult to predict attendance for programming. One session may have a small group; another session could have a large group. While unpredictable attendance did not derail RVAir programs, it required staff to be flexible and responsive; it also made planning difficult at times. One Groundwork RVA staff member suggested offering stipends or increasing pay for teen participants would incentivize participation.

Strengths for Teen Participants

Participants were asked about the strengths of the program for teen participants. Overall, participants mainly identified the following strengths of the program: (1) skill-building opportunities; (2) access and opportunities; (3) place-based learning; (4) youth-centered programming; and (5) social opportunities.

Skill Building

Staff often discussed how teens participating in community science programming developed science and social skills. For example, the Community Science Catalyst said that teens practiced both data collection and developed practical science skills during RVAir programming. On air quality walks, teens not only learned how to operate scientific instruments; they also learned how to orient themselves, reading maps while collecting, reading, and interpreting data. Ultimately, such hands-on skill building was important because, as one Groundwork RVA staff member said, Richmond's public schools often focus on scientific theory rather than hands-on learning. Groundwork RVA teens also practiced social skills, learning to adapt to new spaces and becoming more confident in asking questions.

Access and Opportunities

As one Science Museum staff member said, many teens had not visited the Science Museum with their family or schools, for several reasons. The partnership helps address barriers to Science Museum visitation (e.g., barriers such as money, time, and transportation). By touring the museum and visiting the Forge, teens are able to experiment with new techniques and technologies, from woodworking to computer-assisted drawing. Moreover, they learned to collect data and use scientific tools, all with the guidance of Groundwork RVA and Science Museum staff. As staff said, teens not only learned about science topics but also applied this knowledge to real-world situations; through place-based and hands-on learning, they identified climate inequities and potential solutions in their very own neighborhoods. This exposure to real-world applications of science at work is especially helpful for teens as they look toward potential careers and future interests.

Place-Based Learning

Half of staff discussed how the partnership helped make science, environmental issues, and climate inequity tangible for teens because the project was place-based and hyperlocal. Significantly, many Groundwork RVA teens live in areas with climate inequities; thus, by participating in RVAir, they learned firsthand about the climate issues that affect their daily lives. The museum's Chief Scientist described that teens learned to see their own community in a new way through a scientific lens—this shift in perspective was a "very powerful experience." For instance, as the former Youth Program Manager at Groundworks RVA said teens discovered significantly poor air quality near a restaurant they frequented.

Youth-Centered Programming

Almost half mentioned that their partnership encouraged youth-directed learning. At the Forge, museum staff do not dictate teen activities. Instead, they support teen input, showing teens that their work is valuable and "has a greater purpose for [their] community." As one Groundwork RVA staff member said, the partnership demonstrates to teens the potential for science to positively change urban community spaces.

Social Opportunities

One Groundwork RVA staff member said that teens were able to decompress and connect with their peers on RVAir walks. Especially after months of online learning and isolation, teens wanted an in-person, outdoor activity where they could connect with friends and neighbors.

Challenges for Teen Participants

Participants were asked about the challenges of the program for teens, from their perspective. A few said they could not think of any challenges or were unfamiliar with potential program challenges. The remainder of participants cited the following challenges: (1) getting teens interested in science topics; (2) consistency in participation; and (3) transportation. It is important to note that all of these challenges often occur in afterschool programming. While these typical issues arose, their partnership (and everyone's active engagement) lessened the magnitude of these challenges.

Getting Youth Interested and Involved

A few discussed the challenge of aligning teens' interests with programming topics and keeping teens engaged. As one Groundwork RVA member said, they wanted to make programming different from school by reducing lecture time and creating a more hands-on experience; however, due to limited time, they were not able to dive deeply into topics. Moreover, Science Museum staff had to find an "entry point" for teens' engagement with air quality, as not every teen was initially interested in air quality or science. Thus, during programming, Science Museum staff needed to adapt questions to teens' interests, to make "the data relevant to their lives so it's more than just an hour of volunteer work." Collaborating with Groundwork RVA staff was essential for facilitating connections with teens and creating buy-in, because Groundworks staff had established relationships with teen volunteers.

The Chief Scientist said that, in the future, it would be helpful to involve Groundwork RVA teens earlier in the process, so they have input in selecting community science topics and questions that interest them. Currently, during RVAir programming, teens exercise some freedom of choice—under the umbrella of air quality, they can explore their own ideas and interests. However, the topic of air quality was already chosen by the Science Museum and Groundwork RVA.

Consistency in Participation

A few participants said consistency in participation was a challenge, though one Science Museum staff member said consistent participation is always a challenge with afterschool programs and not unique to RVAir. Science Museum staff also pointed out that because Groundworks had an established relationship with the teens and offered paid internships, participation issues came up less frequently with RVAir compared to other afterschool programs. Still, one Groundwork RVA member said it was a challenge to financially compensate teens, who are looking for a job to earn money, build independence, and gain professional skills.

The shift to online learning during the pandemic also affected recruiting new participants; most teen participants in RVAir had previously participated. One Groundwork RVA staff member said RVAir can continue to broaden their outreach and data collection in the future, and they suggested reaching out to Richmond Public Schools to increase participation now that in-person learning has resumed.

Transportation

A few participants said that it could be challenging for some teens to find transportation to the Science Museum. Additionally, bus or van occupancy can limit how many teens can attend a program. However, Groundwork RVA and Science Museum staff mentioned how they worked to mitigate transportation issues: Groundwork RVA had their own bus (they did not have to rely on Richmond Public School transportation) and the Science Museum collaborated with Groundwork RVA to find convenient after school meeting locations.

Relationship Over Time

Participants were asked how, if at all, has the relationship between Groundwork RVA and the Science Museum changed over time. Overall, staff at both organizations reiterated that their relationship has grown deeper and "more intentional." Each organization has gone through organizational shifts and staff transitions. However, over the years, the Science Museum and Groundwork RVA maintained a relationship by reestablishing connections and finding tangible overlap in their institutional goals. Thus, they have developed a more formalized but still highly collaborative and "reciprocal" approach to their work together.

Participants also pinpointed three key areas in which their relationship has grown: funding (i.e., models and goals), planning, and environmentalism in urban areas.

"I feel like we have just as much opportunity to highlight the value the Science Museum brings to the table. So, places we are able to highlight, we are intentional about in doing so. So, we are giving as much back and it's not just a pat on the head for the non-profit, but more like a partner, able to sit at a table and problem solve."
—Groundwork RVA staff member

Collaborative Planning

Some staff discussed how the planning process between Groundwork RVA and the Science Museum has become more collaborative and intentional. For example, when applying for a grant or planning projects, they consider how they can include each other's feedback or input. One Groundwork RVA staff member praised the Science Museum's Chief Scientist and Community Science Catalyst for operating with "intention" in their work—they ask how they can include Groundwork RVA in the Science Museum's work. At the same time, Groundwork RVA staff members ask how they can highlight Science Museum projects where Groundwork RVA teens are involved.

In addition to developing reciprocity, both organizations have explored funding approaches that better support their partnership. For example, the Chief Scientist said that during the Urban Heat Island Study, their work and data collection was almost entirely volunteer-based. Yet, as the Science Museum and Groundwork RVA obtained more financial support for their joint projects, they shifted their approach. For example, the Science Museum restructured how its funding is disbursed so that Groundwork RVA staff are paid in advance. This way, Groundwork RVA does not have to incur costs while waiting on a reimbursement process.

Future Opportunities

Participants were asked about future opportunities for the partnership between Groundwork RVA and the Science Museum. Many referenced the importance of their partnership—it has been a strong, reciprocal relationship. For the future, the Science Museum and Groundwork RVA can:

Create more funding and leadership opportunities for youth

Science Museum and Groundwork RVA staff were both excited about involving Groundwork RVA teens in the program planning process. Science Museum staff members said they hoped to incorporate even more youth-directed ideas into programming agendas and continue to support teens in implementing real-world solutions in the Forge.

Both organizations also discussed creating more paid, skill-building opportunities for Groundwork RVA teens. More funding would provide compensation for teens and, as one Groundwork RVA staff member pointed out, most likely increase youth participation. A few participants said they hoped that the Science Museum would be able to contract Groundwork RVA's Green workforce; through paid opportunities, youth leaders could learn new green infrastructure skills and practice techniques on the Science Museum's campus. In particular, participants were looking forward to the Science Museum's new 6-acre public green space, The Green—this space can lead to potential collaborations with Groundwork RVA.

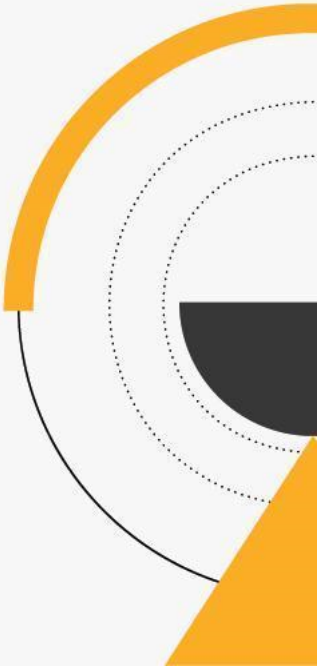
Advocate for more green spaces in Richmond

One Groundwork RVA staff member mentioned how green spaces across the city are important. While teens can visit the Science Museum and its new green space, they also need green spaces in their neighborhoods (for example, Hillside and Southside). Thus, a Groundwork RVA staff member said they hope that the Science Museum's investment in green spaces can spur change in city planning; in the future, they hope the Science Museum's reach can continue to stretch beyond the museum's campus.

Serve as a community connector

A few participants discussed how community science, especially when examining community-driven topics, continues to be a fertile, creative, and effective method of engaging people in science and environmentalism. As Science Museum and Groundwork RVA staff said, the Science Museum has already proven itself as a connector of organizations across Richmond through its community science efforts, building ties with community partners such as Richmond's Office of Sustainability and RVA Green 2050, the city's equity-centered climate action and resilience planning initiative. Participants hope the partnership's focus on urban areas and community science can serve as a tangible model for other cities using community science to examine environmental justice issues.

04 Teen Participant Interviews



Overview

From July to August 2022, Kera Collective conducted 3 telephone interviews with Groundwork RVA teen participants involved in RVAir. Interviews explored motivations for participation, program successes and challenges, and whether RVAir impacted how participants engaged with science and understood environmental issues within their communities.

Overall, teen participants were motivated to join RVAir because friends, family, and extracurricular group members were involved in the project. Significantly, teens valued the social connections they made (i.e., meeting and connecting with neighbors on walks). They also expressed how collecting air quality and participating in science projects was important because RVAir provided youth audiences with concrete tools and methods for understanding their environments, identifying environmental problems, and devising potential solutions. By collecting data locally, they said they viewed their community in a new way and witnessed real-life examples of environmental disparities.

As for challenges with participating in RVAir, teen participants said they felt supported by Science Museum and Groundwork RVA staff, discussing only a few slight obstacles such as scheduling (i.e., fitting RV walkabouts into their afterschool activities) and fixing minor technological issues (i.e., working with the Community Science Catalyst and Groundwork's Youth Program manager to connect the iPad to the sensor).

Participant A

This participant joined because a friend from another local youth extracurricular group they participate in encouraged them to join. During their time participating in RVAir, they enjoyed being able to get out and explore their community in a new way, as well as have a tangible understanding of the air quality data in their community, the meaning of the data, and exploring why there were differences depending on location. They feel that it is important to continue this work with other teens because teens are the future, and by educating them we are giving them the tools to better understand their environment and how to repair it. The only challenges they faced were finding the time to go on their air sampling walks, as they ended up with a tight schedule in between school activities. They would like to see the program continue and encourage other youth to join.

"Groundwork RVA took us to the museum and…it was interesting to me to look at the air quality and using the software to do so…I had never seen it before, and it was interesting to see it in person. It's cool to use because you know the particles are there and you can't see them."

Participant B

Participant B was introduced to this program through their sibling and found that it was a great way for them to meet new people who shared similar interests, and better understand air quality data and the importance of it. This participant expressed that RVAir was both challenging and beneficial in introducing them to new people and acting as a catalyst for them to form new friendships with people who are exploring the same activities, as well as have shared life experiences. They felt that they learned about the disparities of air quality in different communities in Richmond and, with that data, we can better understand the meaning of such disparity. They also expressed that a similar notion as Participant A in teens being the future and including them in the program was imperative for ensuring that future generations understand the effects of air pollution.

"[I most enjoyed] talking to people who can better me as a person, because they've been through stuff I'm going through now."

Participant C

Participant C became interested in joining RVAir after learning about it from a friend. During their experience working with RVAir, they appreciated the opportunity to get outside in their community, make more friends, and understand the importance of air quality data. They were also very interested in understanding how air quality and the pandemic are related, as they were participating during the peak of the pandemic. Their favorite part was being able to connect with a neighbor during their air quality data walks and having the opportunity to learn together.

Participant C said they felt it was important to know more about the air quality in their community and were shocked to find that there was poor air quality in some neighborhoods, especially when it was poor in areas where there were many children. They said it was important to be educated about the air quality in their community so that they could spread awareness and the community could make changes to protect both the Earth and the people that live on it. The only challenges they faced were occasional technical issues; but they felt supported by staff in fixing these issues. They felt supported by the staff and know that, even after leaving the program, they are always welcome to come back and learn more.

> ***"I realized we need to do better with the air, and we need to protect the earth and treat it the way we want to be treated. Surprisingly a lot of people in my community don't know the truth of what is going on… Science is very useful in addressing problems. If I wanted to learn more about the air, I know I could go back to [Groundwork RVA's] Green Team and get the tools."***

04 Appendix

Appendix A: Interview Guide for Science Museum of Virginia Staff

Introductory Script

Hello. My name is _____. Thank you for taking the time to talk with me about the partnership between the Science Museum of VA and Groundwork RVA! I work for Kera Collective, a research firm that is helping the Science Museum with a summative evaluation of its IMLS-funded community science project; in particular, your interview today will help the Science Museum understand their community science partnership with Groundwork RVA and how this relationship has changed over time.

Before we begin, I want to let you know that I will be taking notes during our conversation to provide a record of your responses.

Do you have questions or concerns? **[Pause for response.]**

Then, let's begin.

Describing the Science Museum/Groundwork RVA Partnership

First, let's start with your role in the partnership between Groundwork RVA and the Science Museum and your initial thoughts about this relationship.

1. Please describe your role at the Science Museum and how you are (or were) involved in the Science Museum's partnership with Groundwork RVA? When (i.e., what years) were you involved?
2. In your view, what motivated the Science Museum to develop a community science partnership with Groundwork RVA?
3. In your view, what do you believe were the goals of the partnership?

Specific Activities

Next, let's turn to the specific IMLS-funded RVAir project that Groundwork RVA and the Science Museum collaborated on and discuss their strengths and potential challenges. This project included community science activities with teens, such as activities at The Forge and teens collecting air quality data on bike rides and walks. You can also consider past activities where the Science Museum worked together with Groundwork RVA.

4. What do you see as the strengths of this partnership for teen participants?
    a. **Follow-up if mention**: empowering teen participants with "information, skills, and resources that spur individual and collective action"
5. What do you see as the challenges of this partnership for teen participants?
    a. **Follow-up if mention**: empowering teen participants with "information, skills, and resources that spur individual and collective action"

Implementation

Now, we're going to discuss organizing and implementing these activities with teen participants from the museum's perspective.

6. First, let's discuss how the Science Museum and Groundwork RVA worked together to make the RVAir project happen. In collaborating with Groundwork RVA on the RVAir project, what worked well?
    a. What do you see as the strengths of the Science Museum and Groundwork RVA partnering on these activities? **Follow-up if mention**: the process of working together
7. What could have gone better? Why?
    a. What do you see as the challenges of the Science Museum and Groundwork RVA partnering on these activities? **Follow-up if mention**: the process of working together

Partnership Over Time and Impact

Lastly, let's wrap up by talking about the partnership between Groundwork RVA and the Science Museum over time and its impact on the Science Museum.

8. From your perspective, how, if at all, has the relationship between Groundwork RVA and the Science Museum changed over time?
9. What is the most significant change that has occurred at the Science Museum as a result of the Science Museum partnering with Groundwork RVA? Why is this significant?
    a. **Prob if mention**: reflecting, respecting, and addressing the needs of the communities it serves
10. Lastly, what opportunities do you see to strengthen this partnership with Groundwork RVA in the future?

Thank you for your time!

Appendix B: Interview Guide for Groundwork RVA Staff

Introductory Script

Hello. My name is _____. Thank you for taking the time to talk with me about the partnership between the Science Museum of VA and Groundwork RVA! I work for Kera Collective, a research firm that is helping the Science Museum with a summative evaluation of its IMLS-funded community science project; in particular, your interview today will help the Science Museum understand their community science partnership with Groundwork RVA and how this relationship has changed over time.

Before we begin, I want to let you know that I will be taking notes during our conversation to provide a record of your responses.

Do you have questions or concerns? **[Pause for response.]**

Then, let's begin.

Describing the Science Museum/Groundwork RVA Partnership

First, let's start with your role in the partnership between Groundwork RVA and the Science Museum and your initial thoughts about this relationship.

1. Please describe your role at Groundwork RVA and how you are (or were) involved in Groundwork's partnership with the Science Museum? When (i.e., what years) were you involved?
2. In your view, what motivated Groundwork RVA to develop a community science partnership with the Science Museum?
3. In your view, what do you believe were the goals of the partnership?

Specific Activities

Next, let's turn to the specific IMLS-funded RVAir project that Groundwork RVA and the Science Museum collaborated on and discuss their strengths and potential challenges. This project included community science activities with teens, such as activities at the Science Museum's The Forge and teens collecting air quality data on bike rides and walks. You can also consider past activities where Groundwork RVA worked together with the Science Museum.

4. What do you see as the strengths of this partnership for the teen participants?
    a. **Follow-up if mention**: empowering teen participants with "information, skills, and resources that spur individual and collective action"
5. What do you see as the challenges of this partnership for the teen participants?
    a. **Follow-up if mention**: empowering teen participants with "information, skills, and resources that spur individual and collective action"

Implementation

Now, we're going to discuss organizing and implementing these activities with teen participants from your organization's perspective.

6. First, let's discuss how Groundwork RVA and the Science Museum worked together to make the RVAir project happen. In collaborating with the Science Museum on the RVAir project, what worked well?
    a. What do you see as the strengths of Groundwork RVA and the Science Museum partnering on these activities? **Follow-up if mention**: the process of working together
7. What could have gone better? Why?
    a. What do you see as the challenges of Groundwork RVA and the Science Museum partnering on these activities? **Follow-up if mention**: the process of working together

Partnership Over Time and Impact

Lastly, let's wrap up by talking about the partnership between Groundwork RVA and the Science Museum over time and its impact on Groundwork RVA.

8. From your perspective, how, if at all, has the relationship between Groundwork RVA and the Science Museum changed over time?
9. What is the most significant change that has occurred at Groundwork RVA as a result of Groundwork partnering with the Science Museum? Why is this significant?
    a. **Follow-up if mention**: reflecting, respecting, and addressing the needs of the communities it serves
10. Lastly, what opportunities do you see to strengthen this partnership with the Science Museum in the future?

Thank you for your time!

Appendix C: Interview Guide for Teen Participants

Introductory Script
Hello. My name is _____. Thank you for taking the time to talk with me about your experience with Groundwork RVA and the Science Museum of Virginia! I work for Kera Collective, a research firm that is helping the science museum understand their community science partnership with Groundwork RVA.

Your feedback will be used to continue to improve the experience for you and future participants in community science projects with the Science of Museum of Virginia and Groundwork RVA.

I also want to let you know that I do not work for the science museum or Groundwork RVA; I tell you that to encourage your open and honest opinions. All feedback, positive or negative, will help the Science Museum understand how participants like you experience Groundwork RVA and museum programming.

Before we begin, I want to let you know that I will be taking notes during our conversation to provide a record of your responses. However, your name will not be recorded or used in our report. Your participation is completely voluntary, and you can stop at any time.

Do you have questions or concerns? **[Pause for response.]**

Then, let's begin.

Involvement in Groundwork RVA and the Science Museum Partnership
First, let's start with how you first got involved with Groundwork RVA and their projects with the science museum.

1. How long have you been involved with Groundwork RVA?
2. How did you become interested in participating in Groundwork RVA projects?

Air Quality Community Science Activities
Next, let's turn to specific activities that you participated in at Groundwork RVA or the science museum. First, we will discuss participating in the air quality data collection experience, RVAir. This included training on how to use the air quality sensors, participating in data collection walks or bike rides, and projects at The Forge at the science museum—a makerspace at the museum with tools and materials (for example, these activities at the Forge included using laser cutters and Inkscape to design and create signage for a garden/farm). You may have participated in all these activities or maybe just one or two. Either way, we want to hear about your experiences.

3. What motivated you to participate in RVAir?
4. What did you enjoy the most about participating in RVAir? Why?
5. What was the most challenging? Or any barriers?
6. What, if anything, would you change about RVAir?

Impact of the Science Museum/Groundwork RVA Partnership

Lastly, we're going to talk about the impact of participating in RVAir.

7. Why, if it all, do you think it is important to collect air quality data in your community?
8. These activities were created through a partnership between Groundwork RVA and the science museum. Why do you think the science museum was interested with working with teens at Groundwork for this project?
9. How, if at all, did this project change the way you see your community, and what related challenges in the community did you identify?
10. How, if at all, did participating in this project make you think about the ways science can be used to address a community problem?
    a. **Follow-up if mention** gaining information, skills, resources, or confidence
11. Is there anything else you would like to share with the Science Museum and Groundwork RVA?

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Kera Collective explores, measures, and furthers the meaning-making that occurs between museums and people.

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