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fDiscover SCIENCE with Dr. Bear®

Summative Evaluation Report

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Executive Summary

In 2017, the Center for Translational Research, part of the Children's Research Institute (CRI) at the Children's National Medical Center, undertook a National Institutes of Health Award (#1R25Od023773-01) project called Discover SCIENCE (a Scientific Creative Innovative Engaging New Cool Experience) with Dr. Bear (henceforth: Discover SCIENCE). Discover SCIENCE aimed to create, test, and disseminate a high-quality STEM/health curriculum through partnerships with two area library systems: Washington, DC Public Libraries and Enoch Pratt Free Library in Baltimore.

The project's target audience was African-American, African, and Hispanic youth—many of whom live in neighborhoods where schools are under-resourced, and where lack of STEM exposure has historically impeded the pursuit of scientific and biomedical careers. To rectify this deficiency, Discover SCIENCE brought STEM learning out of the classroom and into community-based settings. With help from project partners, CRI staff created an out-of-school time (OST) curriculum for children grades K–5. Revolving around hands-on, art-focused learning modules, the curriculum was implemented by non-experts, and had four ***general aims***:

- Expose learners to the fundamental interaction between the environment, health, and disease prevention through exposure to scientific thinking, asking, and answering questions, and gathering and assessing data;
- Meet Next Generation Science Standards (NGSS), Common Core State Standards (CCSS), and local and other evolving national standards using art and manipulation to further scientific and health concepts;
- Ensure that computation, imaging, and engineering constructs are intrinsic to each module; and
- Evaluate effectiveness and continuously improve programming through external evaluation.

The work of Discover SCIENCE toward these aims was guided by ***specific actions***: 1) Program modification, 2) Creation of specialized STEM programming for learners and families, and 3) Professional Development.

Throughout the project, Knology served as an external evaluator for Discover SCIENCE. Our primary role was to ascertain the project's impact on its target audiences, and more specifically, to determine whether or not the design and implementation of the curriculum met the aforementioned aims. Knology employed a mixed methods evaluation strategy (triangulating between surveys, focus groups, interviews, and in-person observations) to gather data speaking to the experiences of youth, educators working in informal learning settings, parents/caregivers, and other community members involved with Discover SCIENCE. In our annual reports, we tracked the project's development and provided recommendations aimed at strengthening Discover SCIENCE through a continuous feedback loop to support improvement. This report presents the results of that work, and discusses how effectively Discover SCIENCE met its objectives.

The report focuses on three impact areas that Discover SCIENCE targeted: ***knowledge***, ***attitudes***, and ***behavior***. All of these relate to the project's general aims and specific actions. In terms of knowledge, we asked whether Discover SCIENCE ***increased children's STEM and health-related literacy skills***, and if it helped ***build a culture of shared learning*** among children and their families. We also asked if the project gave facilitators the knowledge and skills required to implement the curriculum. To consider impact on attitudes, we examined whether Discover SCIENCE ***fostered excitement about health and STEM and health-related careers*** among children, and if the project gave facilitators confidence teaching on STEM and health-related topics. Lastly, we looked at whether Discover SCIENCE ***promoted healthy and active lifestyle*** behaviors among children and their peers, siblings, and parents/caregivers.

Accomplishments & Impacts

Our evaluation of Discover SCIENCE revealed that the project met each of its intended outcomes. CRI staff succeeded in creating an innovative model of STEM and health learning, and disseminating it into a variety of OST contexts, yielding the following results:

Knowledge

- Discover SCIENCE facilitated children's intellectual growth, yielding gains in STEM and health-related knowledge, while also helping to build their critical thinking faculties.
- Discover SCIENCE increased curriculum facilitators' science and health-related literacy, and made them more knowledgeable about the health issues facing underserved communities.
- Discover SCIENCE imparted critical information about health and the human body to children's peers, siblings, and families, which can be used to support an intergenerational, community-wide culture of STEM and health learning.

Attitudes

- Discover SCIENCE piqued learners' curiosities about health and the human body, and generated excitement for both learning about and doing science.
- Discover SCIENCE promoted positive identifications with STEM and health-related professions among children, and served as an effective introduction to careers in these fields.
- Discover SCIENCE made curriculum facilitators more confident and comfortable teaching on a variety of STEM and health-related topics.

Behavior

- Discover SCIENCE helped children translate knowledge of the body into specific activities designed to preserve and promote human health.
- Discover SCIENCE promoted the uptake of healthy habits, and encouraged children to incorporate disease prevention strategies into their day-to-day lives.
- Discover SCIENCE helped forge communal ties and provided a means for facilitators to give back to the communities they serve.

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Introduction

Despite its historic reputation as a global leader in science, technology, and medicine, today, the United States finds itself with a shortage of qualified professionals in many STEM and health-related fields (Xue & Larson, 2015). To address this deficit, government agencies, scientific organizations, and philanthropic leaders have banded together to support numerous initiatives aimed at sustaining and strengthening the STEM and health workforces. As positive STEM and health experiences in early childhood have been shown to increase the likelihood of pursuing scientific and biomedical careers later in life, many of these initiatives target youth in elementary and middle school (Bevan et al, 2010). Existing research has demonstrated that many children lack access to high-quality STEM and health learning opportunities. Particularly acute is this problem among racial minorities, members of historically underserved communities, and girls (Garibay, 2013). If the United States is to succeed in creating a diverse, successful new class of math, science, and biomedical professionals, members of these groups must be included in any plan to strengthen the STEM and health sciences workforces.

With this long-term goal in mind, in 2017, the Center for Translational Research, part of the Children's Research Institute (CRI) at the Children's National Medical Center (Children's National), initiated a project called Discover SCIENCE with Dr. Bear. Supported by the District of Columbia Public Library (DCPL) system, numerous community partners, and a National Institutes of Health (NIH) Science Education Partnership Award (SEPA– 5R25GM129225-05), Discover SCIENCE aimed to create, test, and disseminate high-quality STEM and health learning opportunities for children in high-poverty communities. The project's target audience was African-American, African, and Hispanic youth—primarily those living in neighborhoods where schools are under-resourced, and where lack of exposure to STEM and health education has historically impeded the pursuit of careers in scientific and biomedical fields. Discover SCIENCE was designed to bring STEM and health learning out of the classroom and into community-based settings to provide an out-of-school time (OST) curriculum for children grades K–5.

Since its launch in 2017, the Discover SCIENCE project has reached hundreds of young learners through informal education programming. Beginning as a library-centered project situated firmly within the Washington, DC and Baltimore metro areas, over the course of the past five years, over 60 in-person and virtual programs have been conducted across 25 DCPL and two Enoch Pratt Free Library (EPFL) sites. Project leaders have brought the Discover SCIENCE curriculum into numerous other OST contexts all across the country—including a summer camp held at Children's National, Girl Scout programs in New York, informal settings in Oregon, and family residences. To date, Discover SCIENCE activities have been carried out by over 60 Girl Scouts of Greater New York (GSGNY) troop leaders in both in-person and virtual settings. On account of challenges posed by COVID-19, from 2020 onward, programming became increasingly multi-dimensional, existing in both in-person and virtual formats. In addition to offering hands-on STEM and health lessons to young

children, the project also provided professional development and training opportunities for educators working in informal learning settings, and promoted intergenerational learning through outreach to parents/caregivers.

A key goal of the Discover SCIENCE team was to develop an innovative, community-based model of STEM and health literacy. As previous research (Maltese et al., 2014) on this subject had shown that textbook-based, test-centered methods of instruction frequently fail to either pique youth interest in STEM and health subjects or to strengthen their critical thinking skills, project leaders strove to create a curriculum revolving around hands-on learning, self-guided discovery, and co-inquiry. Toward this end, project staff developed a series of interactive, hands-on, art-based learning modules, all of which were used to impart knowledge of health care disparities, to encourage the adoption of active, healthy lifestyles, and to generate excitement about disease prevention and STEM and health-related careers. Discover SCIENCE had four ***general aims***:

- Expose learners to the fundamental interaction between the environment, health, and disease prevention through exposure to scientific thinking, asking and answering questions, and gathering and assessing data;
- Meet Next Generation Science Standards (NGSS), Common Core State Standards (CCSS), and local and other evolving national standards using art and manipulation to further scientific and health concepts;
- Ensure that computation, imaging, and engineering constructs are intrinsic to each module; and
- Evaluate effectiveness and continuously improve programming through external evaluation.

The work of Discover SCIENCE was guided by ***specific actions***: 1) Program modification, 2) Creation of specialized STEM programming for learners and families, and 3) Professional Development.

Meeting these goals would enable Discover SCIENCE to contribute to two larger aims: (1) reducing the achievement gap among low-income youth; (2) reducing those health disparities borne of systemic racism and socioeconomic disadvantage.

Throughout the five-year project, Knology served as an external evaluator for Discover SCIENCE. Our goal was to ascertain the project's impact on its target audiences—and more specifically, to determine whether or not the design, implementation, and dissemination of the Discover SCIENCE curriculum met the aforementioned aims. Knology employed a mixed methods parallel evaluation strategy, deploying and triangulating between surveys, focus groups, interviews, and in-person observation to gather data speaking to the experiences of youth, educators working in informal learning settings, parents/caregivers, and other community members involved with Discover SCIENCE. In our annual reports, we tracked the project's development and provided recommendations aimed at strengthening Discover SCIENCE to support a cycle of continuous improvement. This report discusses the extent to which the Discover SCIENCE met project objectives.

We focused the evaluation on three outcomes: ***knowledge***, ***attitudes***, and ***behavior***. We asked whether Discover SCIENCE ***increased children's STEM and health-related literacy skills***, and if it helped ***build a culture of shared learning*** among children and their families. We also asked

if the project gave facilitators the knowledge and skills required to implement the curriculum. To consider impact on attitudes, we examined whether Discover SCIENCE ***fostered excitement about health and STEM and health-related careers*** among children, and if the project gave facilitators confidence teaching on STEM and health-related topics. Lastly, we looked at whether Discover SCIENCE ***promoted healthy and active lifestyle*** behaviors among children and their peers, siblings, and parents/caregivers.

This Report

This summative report presents results from the five-year project. Based on an analysis of data collected during the fifth-year evaluation and a retrospective assessment of data from Discover SCIENCE's first four years, it offers a holistic review of the efficacy of the curriculum and its implementation. The goal of this report is to describe what the project achieved, and to reflect on how effectively its outcomes aligned with project goals.

Our report is organized into eight chapters. Chapter 1, "Project History," discusses the inception and development of the Discover SCIENCE curriculum from 2017 through 2022. Chapter 2, "Evaluation Process Overview," outlines the instruments, protocols, and methodological approaches we utilized when evaluating the program.

From this point onward, we assess project outcomes along four separate lines. Chapter 3, "Curriculum Design," looks at how the modules that provided a foundation for Discover SCIENCE programming were created and modified over the course of the project's five-year history. In chapter 4, "Learner Outcomes," we explore the project's impacts on its primary target audience. In chapter 5, "Facilitator Outcomes," we highlight the experiences of library staff and educators working in informal learning settings. Finally, in chapter 6, "Other Target Audiences," we assess the project's progress toward those learning outcomes dealing with peer and family learning. Comprising the bulk of our summative report, these four chapters detail the results of our evaluative efforts, highlighting examples, data points, and other forms of evidence that substantiate our conclusions as to the project's effectiveness. Some of this evidence is presented in aggregate; at other points, we reference individual, more anecdotal data. Supported from a variety of vantage points, the robustness of our analysis highlights the usefulness of our mixed-methods approach to evaluation.

Chapter 7, "Discussion," summarizes our findings in terms of the program's goals, and identifies specific factors that impacted progress toward these. In a brief conclusion, chapter 8 provides suggestions for future implementation and research.

Project History

Discover SCIENCE grew out of "Being Me," a five-year (2009-2014) NIH-funded project that broadened opportunities for STEM and health learning within the Washington, DC & Prince George's County (MD) public school system. Though successful in developing an in-school curriculum and supporting learning in schools with limited resources and high rates of teacher turnover, "Being Me" faced constraints—many of which related to the challenge of promoting an innovative curriculum within educational settings dominated by the demands of district requirements and test preparation. To overcome this, Discover SCIENCE aimed to adapt existing "Being Me" modules for use in informal learning settings—most notably, libraries. The idea was to equip library workers and other "non-expert" STEM and health facilitators with the tools and knowledge required to teach the existing curriculum in Out-of-School Time (OST) contexts. Through the use of hands-on, art-focused pedagogies, the Discover SCIENCE team looked to provide learners with a richer educational experience, one that would promote scientific literacy, generate interest in STEM and health-related careers, effect behavioral change, strengthen critical thinking skills, and advance pediatric health.

Year 1

To align the project's educational content with the health needs of its target audience, CRI staff constructed a curriculum informed by the results of a 2013 Community Needs Assessment conducted by the RAND Corporation and DC Action (District of Columbia Community Health Needs Assessment, 2013). The assessment highlighted six areas of medical concern: (1) asthma; (2) obesity/cardiometabolic health; (3) behavioral health; (4) stress-related disorders; (5) injury prevention; and (6) genetic diseases. For Discover SCIENCE, these topics laid the foundation for six separate modules: (1) Asthma; (2) Nutrition; (3) Bones; (4) Mindfulness; (5); Sleep; and (6) Genetics.

During the project's first year, a number of DCPL branches engaged on the project, including Height/Benning, Lamond-Riggs, Petworth, Shaw, Mt. Pleasant, and Anacostia. So too was EPFL an inaugural member of the Discover SCIENCE initiative. Working together, library staff and CRI educators created five health-focused OST lessons:

- "From Fork to Stomach" (a science experiment that teaches about the digestive system);
- "An Air Affair" (in which participants build lung models with straws and bags and learned about respiratory function);
- "Mucus Madness" (in which participants create "mucus" out of glue, baking soda, and saline solution to learn about asthma, and other things that can make breathing difficult);
- "It's Great to Hydrate" (in which participants learn about the importance of staying hydrated during exercise and throughout the day); and
- "The Nose Knows" (in which participants use beads to create an "asthma trigger bracelet" to learn about environmental factors related to asthma).

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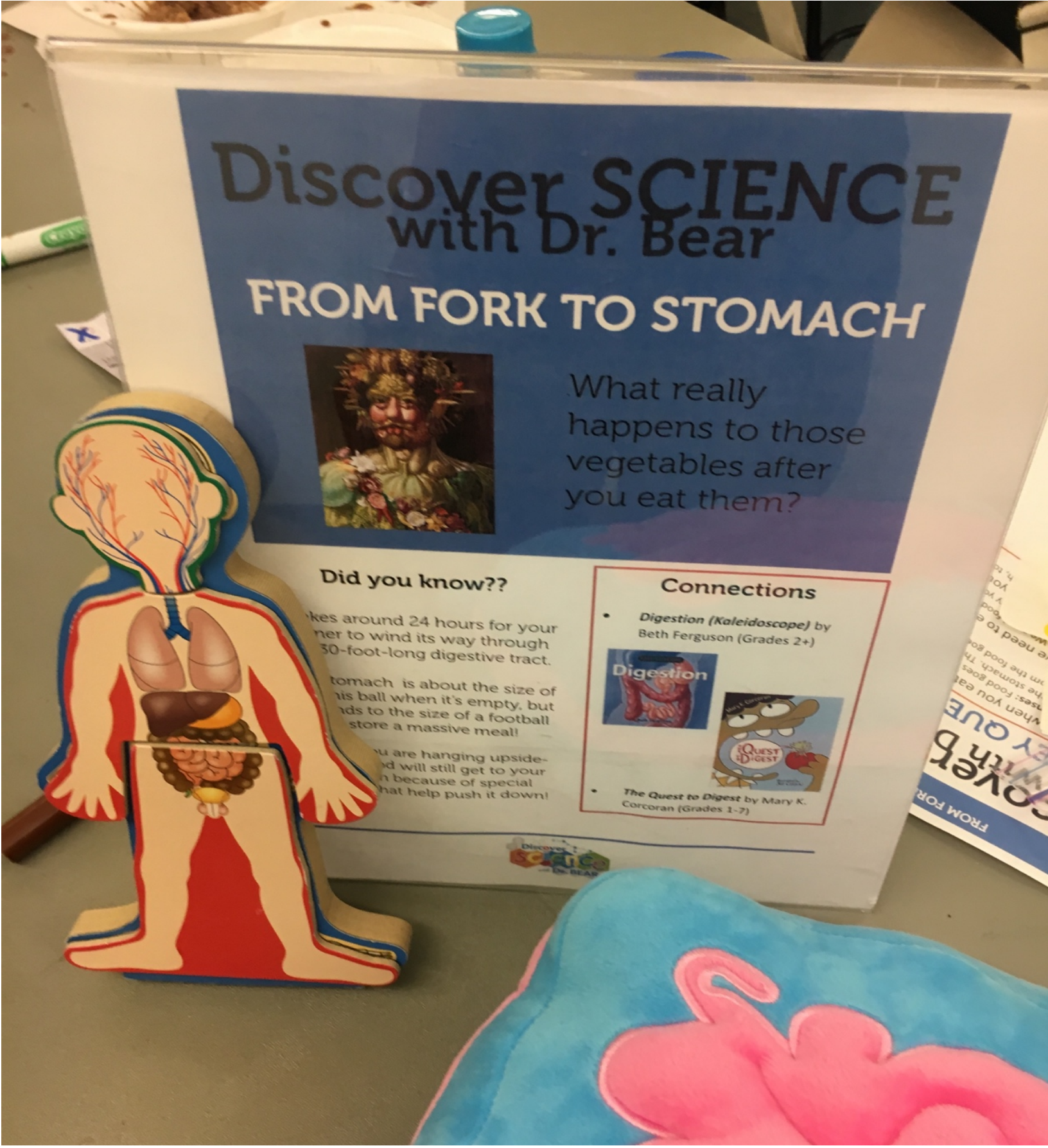


Figure 1. Materials from the "From Fork to Stomach" Module

Year 2

Both the DCPL and the EPFL systems extended their involvement with Discover SCIENCE into the project's second year. In these settings, learners were offered two different types of programming. The first, called "Drop-In Sessions," offered learners the opportunity to progress through a number of stations, each of which revolved around an activity designed to take roughly twenty minutes to complete.

Incredibly hands-on, these activities made use of child-friendly materials like stickers, glitter, and other basic art supplies, and required youth to do things like create art projects out of food stickers, decorate brain waves, and make slime Facilitators employed a variety of pedagogical methods when implementing the curriculum. Some preferred a question-and-answer approach, beginning lessons with questions like "*Do you know what fingerprints are and what they are used for?*" or "*Have you heard of DNA?*" Others opted for a more personal style, asking learners if they knew of anyone affected by asthma, or if they had ever known anyone with a brain injury. These discussions were often supplemented by readings and coloring sheets focusing on the topic addressed in each station.

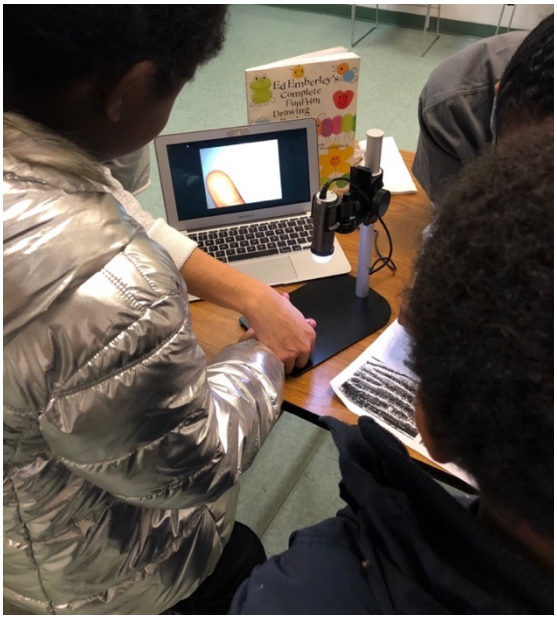


Figure 2. Children Learning about Fingerprinting Technologies

The second kind of program were Family Learning Events (FLEs). Scheduled for two hours, these related multiple activities from the Drop-In Sessions to a particular health theme (for example, nutrition). Library workers, volunteers, and staff from the CRI all contributed to these events, often performing demonstrations designed to both inform and entertain. For example, in a lesson on asthma, a medical student inflated real pig lungs in order to demonstrate respiratory function. Often, outside partners were invited to participate and extend the STEM and health-oriented learning beyond the curriculum's topics. One partner from a brain-injury prevention organization in DC asked participants to try on glasses that simulated a concussion-induced brain injury and work on a brain-related art activity. Youth were then given a protective helmet to take home and keep.

Figure 3. Materials from a Module on Brain Injuries

While libraries remained at the core of the Discover SCIENCE project, during its second year, the curriculum was extended to additional venues—including an event held at Children's National on World Asthma Day, a genetic project carried out at the Woodlin Elementary School STEM night, and a program on asthma and respiratory health held at the Elementary DC STEM fair.

Notably, between June 24 and 28, 2019, CRI sponsored a summer camp program at Children's. Known as Dr. Bear's Cubs Summer Science Experience, this summer camp took place across two main locations within the hospital campus and included two off-campus field trips to the Petworth DCPL branch. At the hospital, campers took field trips to the radiology and robotics labs, an operating room, a healing garden, an emergency room ambulance entrance, and a rooftop helicopter landing pad. Campers also had an opportunity to conduct research, and traveled to the Petworth library to consult books and use computers to look up information related to their chosen topics. Campers were divided into five groups, each of which was led by a high school mentor with a general career interest in STEM or health. Each day had a specific theme, began with a reading exercise, and included a variety of enrichment activities—for example, dissecting a sheep brain, testing out a 3-D printed ankle, trying on surgical scrubs, creating personalized sleep masks, or building robots. During these activities, campers also listened to presentations from hospital staff, and had opportunities to ask questions about different areas of science and biomedicine. One day included a brain dissection and presentations on sleep and dreaming. To facilitate their learning, when moving through different activities throughout each day, campers jotted down observations in notebooks supplied to them by project leaders. Journals were also used for specific assignments—for example, drawing images of what campers thought scientists looked like.

Figure 4. Sleep masks designed by children as part of a module on sleep and dreams

Year 3

Year 3 witnessed a significant expansion. In addition to maintaining existing partnerships with DCPL and EPFL, project leaders extended the curriculum to new audiences—specifically, the Girl Scouts of Greater New York (GSGNY). Training and professional development activities also began in earnest during Year 3. In October, 2019, thirty GSGNY troop leaders participated in a two-hour in-person training. Project leaders led demonstrations and shared information about the health topics in the curriculum. Six DCPL staff participated in an in-depth professional development training. Although six in-person sessions were planned at the hospital and library, only four were held in-person, while one was delivered virtually, and the last was canceled due to the COVID-19 pandemic.

As this suggests, the March 2020 onset of the COVID-19 pandemic, halfway through Year 3, presented significant challenges to Discover SCIENCE. The virus's rapid spread throughout the country prompted library closures and the cancellation of all scheduled in-person activities, making it impossible for project partners to sponsor the kinds of events and activities held in Year 1 and Year 2. Unable to carry out library-based programming or continue the Summer Science Experience, project leaders adapted the curriculum for use in virtual settings, offering virtual trainings to educators and using internet technologies to deliver an online version of the curriculum.

Major innovations in Year 3 included the refinement of the Discover SCIENCE website (***www.doctorbearscience.com***), the development of educational animated videos with FableVision Studios, and the creation of a new resource handbook. Along with this, the

Discover SCIENCE team created a series of training videos for a number of lessons (including Vaccinated and Fascinated, Starry Night Light, Socktopus, Print Sprint, Mucus Madness, Mindfulness Jars, Let's Make Poop, Germ Swarm, and Bone Zone) that provided facilitators with step-by-step instructions on how to guide children through activities, discussions, and other curricular content. These resources helped participants adapt to the new circumstances created by the pandemic, and contributed to the program's value and reach in the longer term. The website and the handbook (sent to OST facilitators in the mail) also eased Discover SCIENCE's expansion into new OST settings (such as GSGNY troop sessions), by providing lessons, educational videos, reading lists, and other health-related information that could be used for either in-person or at-home learning. The new guidebook also piloted an increased focus on health careers, providing information about a related career in the biomedical sciences for participants to discuss.

Year 4

Adjustments to the project made during the early months of the COVID-19 pandemic provided a foundation for Discover SCIENCE's fourth year. Facilitators at both DCPL branches and GSGNY participated in new virtual training sessions, where they learned how to administer the curriculum. Although the pandemic continued to impact DCPL programming, project leaders adapted more curricular content for use in virtual settings—for example, by publishing lessons on the library system YouTube channel (***www.youtube.com/c/dcpubliclibrary***), which was open to the public for asynchronous viewing. Covering lessons from the six different health topics, virtual meetings typically lasted from between 30 minutes and 2 hours. Activities ranged from learning about DNA through building "Dr. Bear bracelets" to a crafting exercise with Q-tips designed to teach youth about the human skeleton. For a new COVID-19 module, Girl Scouts made models of viruses and vaccines while learning about blood vessels and blood cells. Many modules also included coloring activities, which facilitated learning about topics such as how food moves through the body. At times, youth lacked the materials required for participation in these activities, but troop leaders circumvented this difficulty by asking girls to locate similar items in their homes (for example, putting sticker mirrors on construction paper instead of creating tinfoil mirrors).

The project team also continued to improve the Guidebook, and began adding examples of real faculty, staff, and other hospital workers into each activity. This addition emphasized the wide array of career paths open to those with training in STEM and health-related fields, and also celebrated the diversity of people who work at Children's. The team also reevaluated and restructured the activities' connections to NGSS and CCSS, finding common threads such as exploration of the environment/climate sciences, nature and adaption to environments, evolution, and engineering.

Figure 5. Screenshot from the Discover SCIENCE YouTube channel

Year 4 also brought new partners into the fold. New York Edge (*www.newyorkedge.org*), an afterschool network that exists to "*bridge the opportunity among students in underinvested communities*," began incorporating the curriculum into its own afterschool programs. New York State Network for Youth Success (NYSNYS) also joined the project, and conversations with the Charles Mott Foundation (*www.statewideafterschoolnetworks.net*) revealed that many other afterschool programs were interested in the Discover SCIENCE curriculum.

Year 5

Year 5 brought a number of new partners into the Discover SCIENCE community. GSGNY, DCPL, and New York Edge continued to program activities, and were joined by several other organizations, including Oregon Ask. Through connections made by Oregon Ask & NYSNYS, a few local Oregon and New York chapters of the YMCA & the Boys and Girls Club of America were introduced to Discover SCIENCE. CRI staff also worked with the Kiwanis Foundation to host a daylong Family Learning Event style session run by DC-based Circle-K volunteers.

To keep up with these expansions, Year 5 saw CRI staff offering more training sessions. In all, during Year 5, over 115 individuals participated in training sessions, including facilitators affiliated with DCPL, GSGNY, NYSNYS, New York EDGE, and Oregon Ask.

Year 5 also witnessed the return of in-person Discover SCIENCE programming within library settings. In Year 5, 37 library professionals across 25 DCPL branches implemented Discover SCIENCE programs. GSGNY leaders also conducted more Discover SCIENCE activities, and as the grant ends, the system's leaders have assumed ownership of continued program delivery.

At the conclusion of Year 5, Knology and the CRI team are completing submission of a peer-reviewed journal article about how a lattice mentorship model helps young learners develop STEM and health-related skill capacities.

Figure 6. Learners participate in the "Let's Make Poop" module

Evaluation Process Overview

As the external evaluator of Discover SCIENCE, Knology developed a series of instruments to measure progress against grant goals. Over the five-year project, our use of these tools—which included direct observations, interviews and focus groups, surveys, desk reviews, and informal conversations—evolved considerably, adapting to meet the ever-changing nature of the project and the unexpected impacts of the pandemic. These tools formed the backbone of an evaluative strategy that allowed us to assess each and every one of the project's various components, and to determine the extent to which these aligned with and met its desired outcomes. All project instruments can be found in Appendix A.

Our assessment goals were twofold. We sought to determine whether or not Discover SCIENCE achieved its desired learning outcomes. Our evaluation protocols also helped us identify particular strengths and weaknesses of the curriculum, and to make recommendations to project partners aimed at helping them improve those aspects of the project in need of modification.

This chapter details the ways we tracked the progress of the Discover SCIENCE project between its beginning in October 2018 and its conclusion in September 2022.

Methods

Key Questions

To determine whether or not Discover SCIENCE was producing changes in knowledge, attitude, and behavior, our evaluation was designed to yield quantitative and qualitative data about the curriculum and the impact of its implementation on facilitators, learners, and other target audiences such as caregivers and families. When thinking about each of these groups, our key questions were as follows:

Curriculum

- Did the curriculum put forward an innovative science and health literacy model, one that revolved around hands-on, arts-focused activities?
- Did the curriculum's design reflect the basic principles of effective OST programming, and were modules created with OST contexts in mind?
- Did the curriculum overcome expected barriers to engagement and learning?

Learners

- Did Discover SCIENCE reach its target audience?
- Did learners find Discover SCIENCE content engaging?
- Did the curriculum build STEM and health-related literacy among learners?
- Did the curriculum strengthen learners' critical/creative thinking, reasoning, and problem-solving skills?

Facilitators

- Did participation in training and professional development sessions make facilitators more knowledgeable about STEM and health-related topics?
- Did these sessions strengthen facilitators' pedagogical skills?
- Did these sessions build facilitators' confidence in teaching STEM and health-related topics?

Other Target Audiences

- Did Discover SCIENCE help learners' parents/caregivers, siblings, and peers become more knowledgeable about STEM and health-related topics?
- Did Discover SCIENCE succeed in creating a learning community among partners?
- Did Discover SCIENCE advance the goals of pediatric health within learners' communities?

Assessment Tools

Knology employed a series of instruments and protocols for tracking the development and implementation of the curriculum. These tools, listed in the table below, allowed us to assess project outcomes for leaners, facilitators, and other target audiences.

Table 1. Assessments Tools by Year and Site

Name of tool	Years used	Sites used
In-person observations	1-2, 3-4 (planned)	DCPL, EPFL, GSGNY
Focus groups and interviews	1-5	DCPL, EPFL, GSGNY, NYSNYS, Oregon Ask, New York Edge
Surveys	1-5	CRI, DCPL, EPFL, GSGNY
Desk reviews	3-4	Discover SCIENCE Website & Handbook
Informal conversations	1-5	CRI

In-Person Observations

To gather data pertaining to learner outcomes, during Year 1 of the project, our observation protocol was designed to obtain information on three key points: (1) demographics; (2) desired outcomes (for both youth and caregivers); (3) usability of information. This protocol (see Appendix A) was used during Year 1 for in-person studies at libraries engaging in Discover SCIENCE programming activities.

As the program progressed into Year 2, we revised and updated this instrument. For the Summer Science camp (see Appendix B), we created an "Activity Observation and Interaction Guide," which allowed us to measure campers' engagement with activities, their interactions with peers and facilitators, and to have brief discussions about STEM or health learning with campers' mentors. Adapted from our library-based programming evaluation, this protocol was employed whenever Knology staff visited the camp programs. We also used these opportunities to record conversations with team members.

Due to ethical concerns over privacy, we did not directly observe any of the online Zoom sessions scheduled during Year 3-5 of the project, when the pandemic prompted a suspension of in-person events and a shift to virtual programming.

Focus Groups and Interviews

The data gathered with our observation protocol afforded insights into processes of learning and behavioral change during Discover SCIENCE events. We also recognized the value of directly engaging with project participants and facilitators before and after programming activities using a number of interview protocols:

- Intercept interviews;
- Semi-structured interviews; and
- Focus groups

The intercept interview protocol (see Appendix A) was used to initiate conversations with caregivers at the conclusion of an event. In these informal conversations, conducted after securing caregivers' verbal consent, we asked about youth interest in the modules, about existing barriers to engagement, and about means for extending the curriculum to better support the goals of intergenerational learning. Information was recorded anonymously, and used to enrich and qualify data acquired through direct lesson observations. These supplementary data were particularly useful for understanding if knowledge shared through modules would be reinforced later in the home.

In Year 2, we developed a new protocol (see Appendix B) for conducting end-of-week interview sessions with campers and their teen mentors. When speaking with mentors, we asked for information about their overall experience, about particular highlights from camp, and any suggestions they had for future camping programs. Discussions with learners were conducted via proxy, through teen mentors trained to use the protocol in a discussion forum with the small group of campers they had mentored.

In addition to holding one-on-one interviews with individual program participants, we regularly conducted focus groups or discussions with curriculum facilitators (see appendix A-C). Our focus group protocols were often used as a follow-up to survey research, and provided us with an opportunity to enrich our understanding of feedback supplied via quantitative instruments. Combining these data allowed us to determine what facilitators needed to implement the curriculum, to assess the effectiveness of the training and professional development sessions offered to library workers and educators working in informal learning settings, and to evaluate the impact of programming on children and other target audiences. Focus groups were also useful for identifying potential barriers to learner engagement, and for developing strategies for extending learning outcomes to parents, caregivers, and families.

Our initial interview protocols were developed for use with library workers (see Appendix A). With the onset of the COVID-19 pandemic during Year 3 of the project, we conducted interviews and focus groups via Zoom (see Appendix C). In Year 4, we resumed our original protocols for non-library programming. We spoke with facilitators from GSGNY and DCPL who completed the virtual Discover SCIENCE training course. Our goals were to determine if the curriculum could be adapted to online contexts, and to assess whether programming in

other OST settings would help the Discover SCIENCE team achieve its overall project goals. All discussions were recorded with permission and analyzed from either notes or transcripts in order to identify key themes.

All interviews were facilitated by a pair of Knology evaluators: one who moderated the conversation and a second who took notes. After obtaining participants' consent, we recorded these conversations, and transcribed the recording to supplement our notes. Transcripts and notes were used together for analysis.

Surveys

To generate aggregate data about the experiences of children, facilitators, and other target audiences, we administered surveys focusing on different attributes of the project, including curricular design, training and professional development, and programming. Many surveys included an open-ended feedback component. Surveys were typically distributed by email to CRI staff, DCPL staff, GSGNY leaders, and other facilitators. In Year 1, we surveyed doctors and nurses working at Children's National to understand how they provide educational content to families and patients in the related health areas of the grant (see Appendix A). During Year 2, we used a "Post-Camp Survey" to directly engage with children, who were invited to reply to a series of prompts with emojis indicating how they felt about the Discover SCIENCE Summer experience (see Appendix B).

To gather feedback on learner outcomes in Year 4 and Year 5 of the project, we designed a survey to examine the impact of different training approaches on facilitators' abilities to implement Discover SCIENCE lessons (see Appendix C). Our goal was to determine the exact kinds of instruction and guidance facilitators needed in order to successfully lead learners through activities. Toward that end, we asked those DCPL staff who took part in professional development sessions if they were satisfied with the training they received, and if this provided resources on health topics that could enrich their professional practices. This survey concluded with an open-ended question asking for suggestions on how to improve the quality of Discover SCIENCE's professional development offerings.

Desk Reviews

Throughout the project, Knology periodically conducted direct assessments of Discover SCIENCE content. Most notably, in Year 3, we carried out an extensive evaluation of the Discover SCIENCE website. Our evaluation was guided by a consideration of the website's audience (i.e., who we thought it was created for), its design and content, and user impressions of the website (i.e., what users might tell others about the site after visiting it). After independently examining these things, Knology evaluators came together for a recorded reflection session that consolidated our observations into a series of recommendations: one focused on audience, a second dealing with the site's structure, and a third addressing the website's content. These results informed our recommendations on how to reorganize the website, and for creating a new design schematic.

A second form of desk review occurred during Year 4, when Knology independently viewed training videos made available to DCPL staff and reported directly to project leaders on their quality and effectiveness.

Informal Conversations

Throughout the project, Knology maintained regular communication with project leadership via email and video conferencing. These informal conversations intensified in Year 3 of Discover SCIENCE, when CRI staff began to devote more attention to dissemination strategies (that is, ways of bringing the curriculum to new audiences and new OST settings) in order to adapt to the ever-changing situation brought on by the pandemic. During weekly meetings, we helped project leaders identify several new potential outlets for Discover SCIENCE programming. To support continued scaling-up of the project, we regularly met with project leaders (via telephone and videoconferencing software) to chart out the next steps in Discover SCIENCE's evolution. Our conversations centered around the following questions:

- What organizations and groups work with the potential national target audiences?
- What facilitators are best poised to benefit from training and effectively reach youth? What supports will they need to be successful?
- Given the public health crisis presented by the COVID-19 pandemic, are there content modifications or additions that could strengthen the SCIENCE curriculum?

Changes in Evaluation Methods

Although we used each of the above assessment tools over the course of the Discover SCIENCE project, our evaluative efforts shifted dramatically as a result of pandemic-related restrictions. In Year 3, we pivoted from a focus on children toward a focus on facilitators' experiences of the training sessions and their ability and confidence to carry out Discover SCIENCE lessons. Since the project's ultimate goal was to disseminate a new model of STEM and health learning for OST contexts, gathering data on facilitator experiences had always been part of our evaluation plan. But now this aspect of our assessment strategy became more prominent. As Year 3 constituted the midpoint of the project, Knology was asked to help project partners think strategically about how to best bring the curriculum to new audiences and new OST settings. Training additional facilitators was a necessary prerequisite for such expansion, and as such, it was incumbent upon Knology to assess the effectiveness of professional development opportunities, trainings, and orientations to Discover SCIENCE.

Two other factors influenced this pivot. The first stemmed from observations during the first two years of the project. When visiting DCPL branches, we noted that the library staff's ability to take part in Discover SCIENCE programming was regularly impeded by a variety of logistical difficulties and institutional constraints, including competing work-related demands and restrictions on time. DCPL's status as a large urban library system (and the government bureaucracy this entailed) also hindered the curriculum's integration into the library system, as did the slow roll out of the Discover SCIENCE website and onerous contracting between DCPL and CRI. Second, we saw that some staff had little interest in the project, while others were interested but felt insufficiently prepared to administer the curriculum. Taken together, these challenges posed a threat to the project's long-term viability, and as such, Knology and CRI found it prudent to devote more attention to activities that would help project leaders expand the reach of Discover SCIENCE outside of DCPL to GSGNY and other OST settings.

As previously noted, COVID-19 disruptions led to the closure of DCPL libraries during the second half of Year 3, which impeded replication of evaluations undertaken in Years 1 and 2. DCPL's moratorium on Discover SCIENCE programming extended throughout the remainder of Year 3, which made it impossible to continue tracking the curriculum's long-term impact on young learners. Though GSGNY migrated its programming to virtual settings, an inability to secure consent from parents/caregivers made it impossible to collect data directly from learners. Our conclusions on children's learning outcomes thus derived entirely from program facilitators.

Participants

Through a combination of assessment tools, we acquired a significant amount of data over the course of the Discover SCIENCE project. This data provided a secure foundation for our evaluation, and is summarized below:

Table 2. Aggregate Evaluation Data by Instrument and Population

Instrument	Youth	Facilitators	Caregivers
In-person observations	314	N/A	N/A
Surveys	17	39	N/A
Interviews	1	73	4

Note. These numbers reflect individuals who participated in the evaluation process. More individuals, across all three audiences, were exposed to and/or carried out Discover SCIENCE activities throughout the five-year project.

Thematic Findings: Curriculum Design

On the basis of their earlier work during the "Being Me" project, CRI was aware of the negative impact that textbook-based, test-centered approaches to STEM and health-related learning can have on youth interest in science and medicine and on their acquisition of scientific literacy. Discover SCIENCE, therefore, aimed to create a series of modules and activities that diverged from the pedagogical approaches commonly found within formal school settings.

To what extent did the project meet this goal? Did the curriculum put forward an innovative science and health literacy model, one that revolved around hands-on, art-based activities? Did the curriculum's design reflect the basic principles of effective OST programming, and were modules created with OST contexts in mind? And did the curriculum overcome expected barriers to engagement and learning?

Our evaluations revealed that the Discover SCIENCE curriculum was an effective vehicle for STEM and health learning. Over the course of the project's five years, project leaders pioneered an entirely new form of STEM and health learning, one that demonstrated decided advantages over both traditional in-school and after-school programs. Though not always aligned with the unique features of OST settings, the curriculum's flexibility and adaptability allowed for successful incorporation into OST programming efforts. Moreover, through a process of continual adjustment and refinement, the curriculum steadily improved over time, as modules were more closely aligned to their target audiences' needs and circumstances.

In what follows, we substantiate each of these findings, drawing on data collected across a range of sites over the course of the project's five-year implementation.

Finding #1: The Discover SCIENCE curriculum created an innovative model of STEM and health learning

Feedback provided by learners, mentors, and caregivers all confirmed that the Discover SCIENCE curriculum constituted a significant improvement upon existing models of STEM and health learning. Children who attended the summer camp program felt that traditional classroom STEM lessons were "*boring*" in comparison to Discover SCIENCE. Echoing this, when speaking about the many different real-world STEM or health experiences offered via the Summer Science Camp, a mentor described the curriculum as "*an experience you wouldn't get in school*." A caregiver with in-depth knowledge of myriad health topics observed that the curriculum was "*very enlightening*," going far beyond what children learned within formal school settings. Particularly innovative was the use of simulation,

which many found to be a more powerful teaching tool than those traditionally used in classrooms. As one parent said of a module focusing on cerebral function, "*it was sensory—touching the brain*."

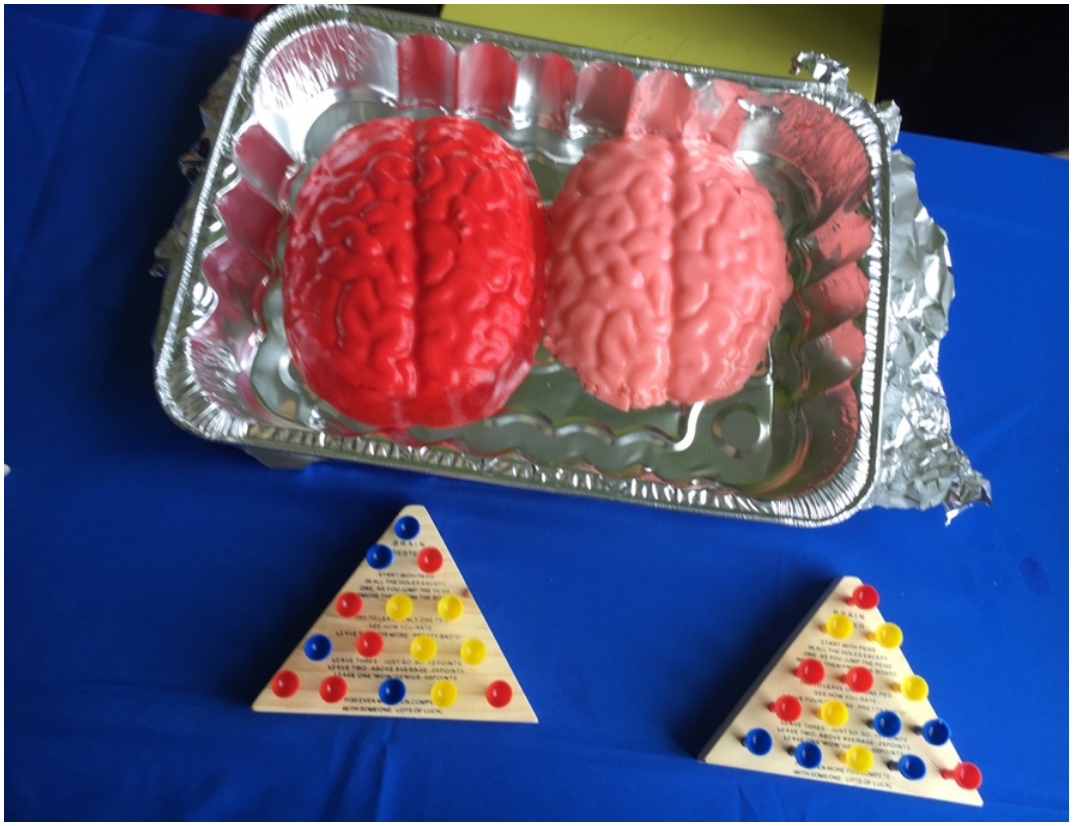


Figure 7. Materials from an exercise focusing on brain function

Facilitators also compared Discover SCIENCE favorably with traditional forms of STEM learning. Commenting on its relationship with school-based forms of instruction, a GSGNY troop leader noted how Discover SCIENCE lessons supplemented knowledge acquired in the classroom, and provided greater clarity on concepts that might be difficult to grasp simply by reading a textbook. As they put it: "*the information in the lesson would be very easy for eighth graders' regent's levels. It breaks it down in a way that's tangible...the students could really get their hands on it*."

Whether taught in libraries, during Girl Scout meetings, or in other OST contexts, the curriculum received high praise from Discover SCIENCE facilitators. When asked about modules, lessons, and activities, facilitators consistently remarked on how well constructed these were. Library staff applauded the lessons for their catchy titles and child-friendly language, and appreciated how the background knowledge associated with individual topics was fun to read and engaging. They found that the child-friendly materials used at each learning station created an environment that was interactive, dynamic, enjoyable, and highly stimulating for young learners. Agreeing with this, GSGNY troop leaders also expressed highly favorable views of the curriculum. Finding lessons easy and straightforward, they remarked on how self-sufficient these were, and also appreciated how they were designed with adaptability and improvisation in mind. When teaching from the COVID-19 module, for example, troop leaders added an activity in which scouts "made" red blood cells. What

resulted from this was an open discussion on the value of vaccines, healthy behaviors, and opinions on scientific facts.

What made the Discover SCIENCE curriculum unique and beneficial when compared to traditional modes of STEM or health-related instruction? In what follows, we highlight the factors that allowed project leaders to create a superior model of STEM and health learning.

Integrated Learning Styles

More than anything else, it was the opportunity to "*get their hands on it*" that made Discover SCIENCE stand out. Through demonstrations that used circuits to teach about digestion, or 3D-printed ankles to explain the principles of physical therapy, activities that required children to build DNA bracelets and robots, and simulations in which learners donned surgical scrubs or sat in the helicopters used to transport hospital patients, youth learned that science is both an intellectual and a physical activity. The curriculum's hands-on modules transformed scientific and biomedical concepts into things that children could simultaneously touch, smell, hear, taste, and see. Tangibility and materiality were hallmarks of the Discover SCIENCE model, and throughout the duration of the project, STEM and health learning was tied to the use of child-friendly supplies and tools like stickers, glitter, duct tape, socks, circuits, and Jell-O. By centering arts and crafts, new media tools, and the making and doing of science, project leaders succeeded in creating a curriculum that far surpassed the book-based pedagogies that typically prevail within traditional educational contexts.

Figure 8. Children completing an exercise as part of the "Let's Make Poop" module

This is not to say that reading was absent from the Discover SCIENCE curriculum. When asked what made this program unique, participants drew attention to the multiplicity of learning styles embedded in the curriculum, noting that hands-on craft-based activities were supported by readings, thematic coloring exercises, and take-home fact sheets. Each lesson contained information on books that could be consulted as supplemental learning resources, and some activities—like the research project incorporated into the Summer Science camp—required learners to familiarize themselves with texts. At troop meetings, Girl Scout leaders sometimes read from storybooks to personalize STEM and health learning, and to make particular concepts more relatable. As all of this indicates, what made the Discover SCIENCE curriculum so innovative was the way it tied together many forms of inquiry-based learning to support a diverse array of learning needs.

Learner-Centered Pedagogy

Whereas most forms of in-school STEM and health education are rigid and teacher-directed, Discover SCIENCE was flexible and learner-directed. During the "Drop-In Sessions" and "Family Learning Events" convened in library settings, children had a wide range of activities to choose from, and it was their preferences and natural curiosities that dictated their path through the curriculum. Similarly, participants in the Summer Science Camp experience were able to independently pursue research projects that spoke to their own interests. Those with dreams of becoming astronauts, for example, were taught how to use telescopes. Those who had previously learned about epidemics, or the conservation of energy were able to use library resources to further their knowledge of these topics.

The wide range of activities offered through Discover SCIENCE programs convinced many children without a pre-existing interest in science or medicine that such subjects were in fact quite enjoyable and meaningful. A troop leader with GSGNY remarked on how much they appreciated the Discover SCIENCE program, telling us:

> *"It's so needed for the girls. It's so fun for me but a lot of girls shy away from it at a certain age and if we continue doing this it helps them see it's not scary and they can do it."*

By giving youth a measure of ownership in the project, Discover SCIENCE created opportunities for the kinds of open-ended, self-directed, inquiry-based STEM and health learning that is rarely seen in traditional educational contexts.

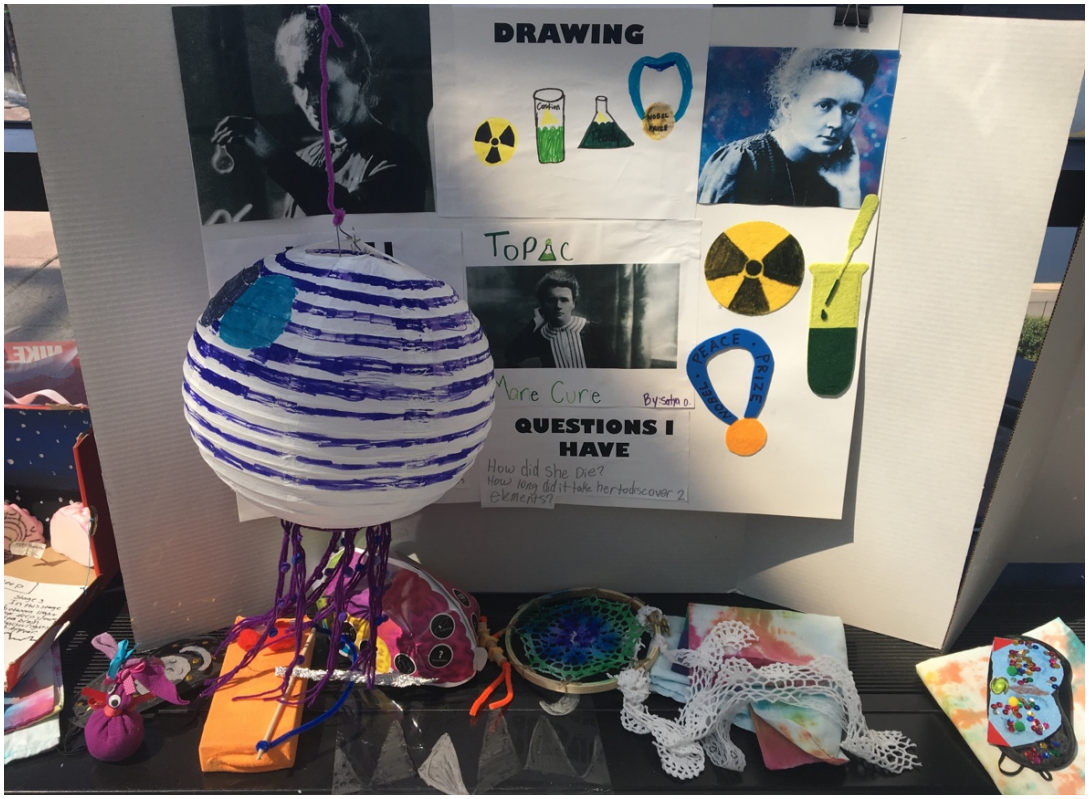


Figure 9. A camper's research presentation

Immersive, Community-Based Learning

Traditional school-based settings provide STEM and health learning that often seems disconnected, episodic, and irregular to learners. Children acquire information in short, isolated bursts, and due to scheduling difficulties, may not always be able to attend after-school events with a STEM or health focus. In contrast, the Discover SCIENCE program made use of a more immersive pedagogy, providing children with an opportunity to fully devote themselves to STEM/health lessons and activities that spanned entire days—and in the case of the Summer Science Camp, a full week. This allowed facilitators to provide more in-depth information about a range of scientific and medical topics, and to build cognitive bridges between past and present content. Steadily building up children's knowledge, the curriculum's intensive and immersive nature was a departure from traditional STEM or health learning models, in which children spend a limited amount of time learning about a particular theory before moving on to an entirely different subject.

The immersive nature of the Discover SCIENCE curriculum created a learning environment comprised of experts, learners, and a variety of facilitators, including caregivers, mentors, and guest speakers. The immersive setting of Children's National allowed campers in the Summer Science program to listen to a scientist from NASA discuss their research, which produced a flurry of interest about life on Mars. On another occasion, campers spoke with an astrophysics graduate student who answered their questions about space. Bringing STEM and health education into OST settings thus gave children knowledge of many different scientific and medical careers and increased their likelihood of personally identifying with STEM and health-related professions.

Finding #2: The Discover SCIENCE curriculum was successfully incorporated into OST contexts

One of the challenges confronting Discover SCIENCE was crafting a curriculum that advanced children's scientific literacy irrespective of age. Whereas traditional school settings serve learners of the same age, in many OST contexts, children of different ages and grade levels are brought together for events and activities. Discover SCIENCE was created to serve children in kindergarten through fifth grade, at different stages of physical and intellectual development.

To what extent did Discover SCIENCE meet this challenge? How age-appropriate was the curriculum? Were learners of different ages able to work together? Were facilitators able to easily modify the curriculum to account for age- and learning-related differences? Were they able to adapt lessons for the mixed-age audience targeted by project leaders?

At the outset, some facilitators were skeptical that Discover SCIENCE could be adapted for use in library settings. Explaining their own reluctance to get involved with programming, one staff member in our Year 1 evaluation noted that they had had "*a lot of experience with people wanting to do stuff in the library and not understanding how young our audience is*." After a few sessions, this library worker experienced a change of heart, and later reported that "*what I really liked about [SCIENCE] was that the activities were very adaptable to how young the kids were. They really enjoyed the program. Nothing was too long for their attention span. I thought it was really cool!*" Echoing this observation, a library worker we interviewed during Year 4 explained that "*kids are curious, and kids at the target age like learning about themselves and their bodies*." Additionally, a Girl Scouts leader noted how "*things I thought would be too young [were actually okay]*."

Our data indicates that the Discover SCIENCE curriculum succeeded in delivering age-appropriate content to children of all ages. Facilitators generally found that the curriculum could be adapted in ways that simultaneously engaged younger and older youth. During DCPL sessions, facilitators often began modules by asking if children were familiar with specific scientific terms like "mucus" or "oxygen." Those unaccustomed to such terms were offered more familiar substitutes, and facilitators employed analogies (for example, comparing bronchial tubes to tree branches) when learners struggled to grasp particular scientific concepts. By contrast, older youth who finished activities quickly were given supplemental tasks (for example, thematic coloring or additional reading) to promote continued engagement and mastery.

Figure 10. Children demonstrating their knowledge of the respiratory system

Girl Scouts leaders found the curriculum adaptable to mixed-age audiences. Describing how the same lesson could be used for both younger and older girls, one leader told us:

> *"My high schoolers loved making blood vessels, blood cells, and models of viruses and vaccines as much as my little ones did … With the older girls, I would give them some vocabulary, the higher-level stuff that you would share more with the adults. And with the little ones, I broke it down a little bit simpler to their level."*

At times, the curriculum was misaligned with learners' physical and intellectual capacities. For example, while most of the modules that comprised the Summer Science camp for campers from second to fifth grade worked equally well across a mixed-age audience, this was not always the case. Some activities—for example, building pipe-cleaner astronauts—were quickly completed by older youth, leaving them with more unstructured, unproductive time. When younger learners saw how easily older campers completed tasks, they sometimes grew frustrated and disengaged. In addition to this, the library-based research project proved difficult for younger campers, as it strained their attention spans and exceeded their cognitive abilities. By contrast, older campers had a relatively easy time researching their chosen topics. Drawing attention to this, in our Year 2 annual report, we

recommended that staff divide campers into different age cohorts, or devise other means for taking age- or learning-related differences into consideration.

These negative experiences were relatively rare. In many cases, having students of different ages work together was advantageous because it presented opportunities for peer-learning and skills development that otherwise would not have been possible. For Girl Scouts, there is an established tradition of older troops mentoring younger cohorts, and having a mixed-age learner population was beneficial here. Many troop leaders identified this aspect of the Discover SCIENCE modules as a highlight. They appreciated how they could call upon older scouts to assist them when explaining different concepts or demonstrating specific activities to younger troops. They reported that by taking on mentorship roles, older Girl Scouts acquired valuable leadership skills.

Finding #3: The "materials-heavy" nature of the curriculum sometimes presented challenges

If there was one aspect of the curriculum that proved challenging, it was ensuring that facilitators and learners had a sufficient supply of crafting materials and supplies. As a facilitator at a YMCA chapter put it, Discover SCIENCE was "*materials heavy*," and required easy access to a sizable quantity of very specific items. In those cases where facilitators already possessed the items needed to carry out a Discover SCIENCE lesson, crafting activities proceeded smoothly. But this was often not the case. Facilitators regularly reported having to purchase materials themselves, and acquiring these materials was quite a "*cumbersome*" task (as one facilitator put it). At times, facilitators found it impossible to obtain the items specified in lesson plans and reported that locating substitutes was often quite a trying task—especially in the context of at-home, virtual sessions, where only "*really crafty people*" could be assumed to have access to the kinds of materials required to complete lesson activities.

Some facilitators recommended that CRI staff publish lists of alternative materials that could be used when a given item was not readily available. Others requested that CRI regularly purchase and distribute activity kits to all Discover SCIENCE sites, to ensure successful completion of crafting activities. One Girl Scouts leader told us that "*if we're doing something with macaroni, make sure that the kids can actually have access to that material*."

It should be noted that the Discover SCIENCE team did incorporate lists of alternative materials into updated lesson plans. So too did they occasionally provide crafting materials, which facilitators acknowledged in their comments. But even when furnished with supplies, facilitators periodically found it necessary to augment these, especially during sessions with dozens of participating children. Finding enough supplies for all children was often challenging—so much so that, according to one DCPL worker, it would have helped if the curriculum included suggestions on how to organize learners into groups, with each group (instead of each child) creating a shared craft.

With regard to DCPL, one particular complicating factor stemmed from the common practice (as one library worker put it) to "*give things away as much as possible*." This was especially

the case with Discover SCIENCE, as many patrons lacked access to the crafting materials needed to complete individual lessons. For this reason, the take-home kits assembled by library staff were generally loaned without an expectation of return. To ensure a steady supply of materials, library workers recommended that project leaders regularly assemble and distribute Discover SCIENCE kits to participating DCPL branches. With library resources already stretched quite thin, DCPL staff universally agreed that the curriculum's implementation would have gone more smoothly had project leaders directly supplied them with all the necessary materials required for each lesson.

In Year 5 of the project, the Discover SCIENCE team worked to meet this need by providing materials needed for the activities to a central DCPL location for distribution. While there was limited capacity for the team to support kit distribution for the network of DCPL branches, this compromise was agreed upon by DCPL and Discover SCIENCE leadership.

Some Girl Scout leaders reached similar conclusions. As one leader put it: "*I would say, supplies wise, we were not supported. We got the packet given to us [and were told] to buy it yourself and it's all up to you*." Supplies specific to Discover SCIENCE activities were sometimes inaccessible—especially in the first year of COVID-19, when physically going to arts and crafts stores was often impossible. As this indicates, the pandemic contributed to many of the materials-related difficulties facilitators experienced. Reflecting on this, project leadership noted how the onset of COVID-19 forced them to move their supplies out of Children's hospital. Though hoping to establish a central materials depot, CRI staff found that they lacked the capacity to create and disseminate Discover SCIENCE kits to all participating DCPL branches. On the positive side, it should be noted that these difficulties had mostly do with the quantity of supplies, not their quality. Indeed, throughout the entire history of the project, only a few facilitators reported problems with materials failing to function in the manner suggested by the instructions.

Finding #4: The Discover SCIENCE curriculum improved significantly over time

The Discover SCIENCE curriculum improved significantly over the project's five-year span, with a substantial increase in content and in the ease and accessibility of the project's website—all of which has led to higher levels of engagement with target audiences. The project debuted with five lessons, all of which were adapted from the prior "Being Me" curriculum. Over the course of the next four years, project leaders steadily expanded the breadth and depth of the curriculum, designing new lessons in response to suggestions from community partners. Year 2 witnessed the introduction of lessons on injury prevention, cardiometabolic risk reduction/bone health, and genetic diseases. In response to a recommendation from Knology, in Year 3, CRI staff pioneered two lessons ("Address that Stress" and "Mindfulness Jars") dealing explicitly with mental health. And in March, 2020, project leaders developed their first lesson ("Germ Swarm") devoted to COVID-19. Speaking to its effectiveness, one Girl Scouts leader explained how this module promoted a "*global discussion*" on the importance of vaccines, hand-washing, and other disease prevention behaviors. By Year 4, there were 19 lessons, and at present, there are 24, including two more

("Body Defenders: Our Immune System" and "Vaccinated and Fascinated") focused on COVID-19.

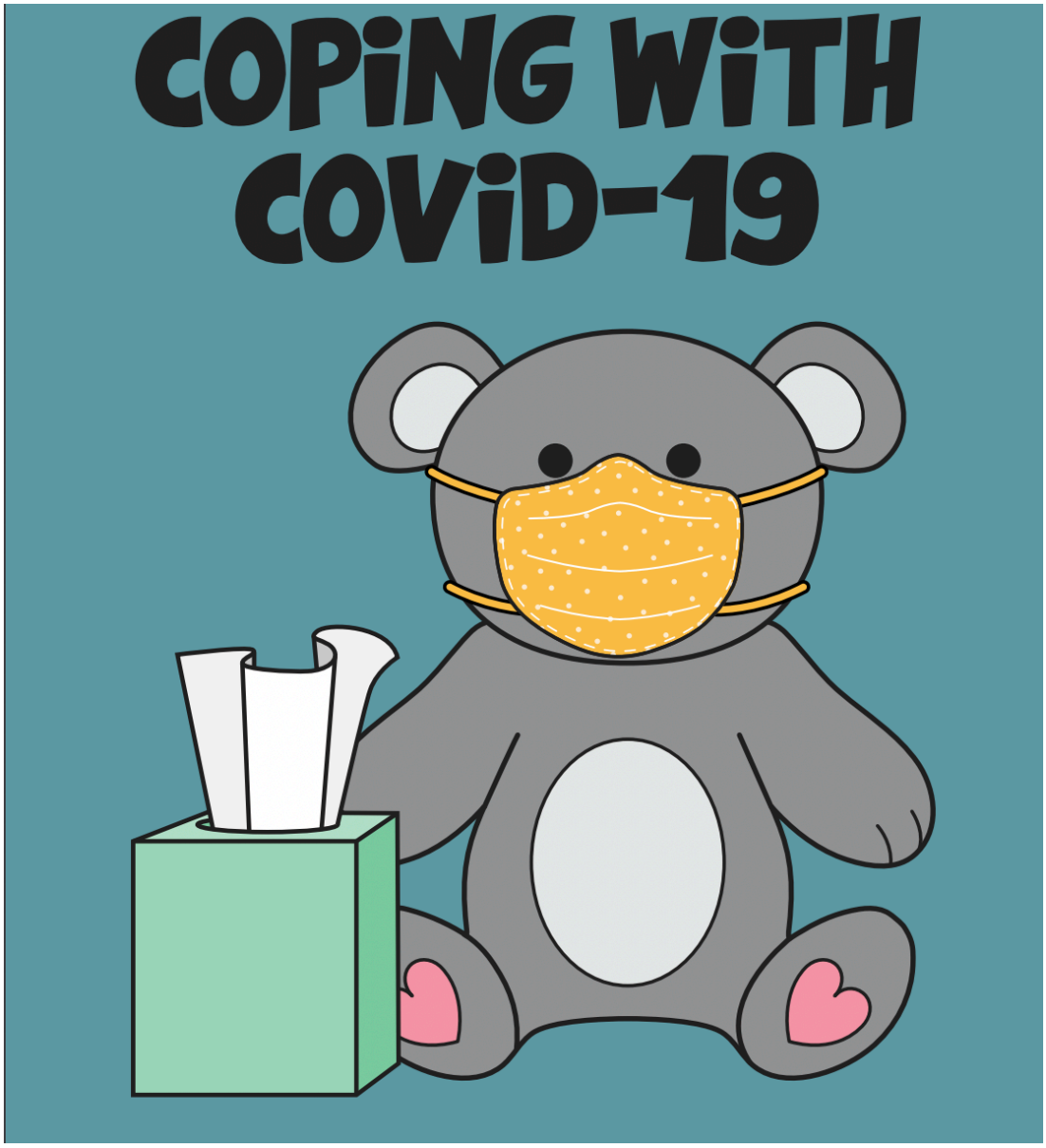


Figure 11. Screenshot from the Discover SCIENCE website's COVID-19 module

As all of this suggests, the Discover SCIENCE curriculum scaled up considerably beyond what was imagined at its inception. The number of lessons increased substantially over time, and as the curriculum grew, it also became more accessible. A major stride came during Year 3, when CRI staff launched the website ***www.doctorbearscience.com***. Designed to "*provide children and families the opportunity to find additional information, vetted websites, fun activities, [and] connections to our faculty mentors and other science-related resources*," the website functioned as a repository for all curricular content. Knology reviewed this website in Year 3 as well. The lessons were considered engaging, fun, and insightfully constructed, but evaluators found the website's architecture somewhat confusing, and concluded that audiences would likely find it difficult to navigate its various pages. To improve its functionality, we recommended that project leaders create three unique pages

for every health topic: one for educators, one for caregivers, and one for youth. Doing this, we predicted, would give each of these audiences the ability to focus solely on content directly of interest to them.

Facilitators recommended other changes to the website. When asked about their use of the site, many Girl Scout leaders requested more sources and videos be added. Noting that the latter would be especially helpful "*if the girls get stuck at home or something*," troop leaders agreed that videos were an essential website resource in the context of the COVID-19 pandemic. So too would this benefit families. As one leader put it, "*a link on the website could get more resources about it. [T]hat could prep families for how to talk about health concepts*." In addition, troop leaders requested that the site be updated with links providing additional background on the topics covered in the lessons.

Taking these suggestions under advisement, at the end of Year 3, CRI staff reorganized the Discover SCIENCE website. The result, as we noted in our Year 3 report, was a "*more intuitive, valuable, and sustainable*" product. In response to facilitators' requests for supplementary background information, the page for each online lesson is now chock full of links. For example, those lessons connected with the module called "Asthma, the Lungs, and Our Environment" include links to information provided by the CDC and the Asthma and Allergy Foundation of America. Along the same lines, the lesson plan pages for these modules now also contain links to text and videos on topics such as "how mRNA vaccines work" and "DNA vs RNA," all of which facilitators can use either in response to children's questions or to provide more in-depth information about the topic being covered within a module. Many of these downloadable lesson plans now contain supplemental content for children—for example, a CDC coloring book called "Coping with COVID-19." Many modules now contain videos that facilitators can directly bring into Discover SCIENCE sessions—for example, short demonstrations that guide children through meditation exercises, yoga, deep breathing, and visualization. Following Knology's recommendations, in Year 4, CRI staff created a virtual version of the Discover SCIENCE Resource Handbook, which gives facilitators easy access to all of the introductory material associated with particular lessons, along with useful tips for effective implementation.

It is especially notable that the website's evolution has helped align learning tools to the specific health needs of marginalized communities. At project conclusion, the Discover SCIENCE website housed content that serves as an introduction to the various topics covered in the curriculum (such as a video on "Genetics and Heredity Traits"), and more specific information about the local health-related concerns of racial minorities. A video called "Living with Sickle Cell Disease: Bryce's Story," for example, highlights the fact that African Americans are more likely to be born with sickle cell trait than are people of other races.

Improvements to the Discover SCIENCE website have yielded tangible benefits for the Discover SCIENCE project. As Table 3 on the next page indicates, even when accounting for visits made by project partners, website traffic has steadily increased over the course of the project.

Table 3. Traffic on the Discover SCIENCE Website (doctorbearscience.com), 2018-2022

Calendar year	Views	Visitors	% Unique visitors
2018	637	164	26%
2019	2246	755	34%
2020	4184	1656	40%
2021	5811	3261	56%
2022*	5446	2355	43%

Note. *Data for 2022 was compiled in September 2022, prior to the year's end.

Table 3 provides data pertaining to use of the Discover SCIENCE website. The column titled "Visitors" documents the number of individuals who visited the website each year, while the column called "Views" lists the number of page views their visits generated. As can be seen, both views and visitors have increased steadily since the website's launch in 2018. Moreover, as the data organized in the rightmost column indicates, with the passage of time, an increasing percentage of these website users have been "unique visitors"—that is, users visiting the site for the first time. While the data in the "Visitors" column is an aggregate sum, that under "% Unique visitors" does not account for repeat visits. Whereas in 2018, only 26% of all traffic was generated by unique visitors, in 2021, this rose to 56%.

Additional evidence for the website's popularity can be seen in data on PDF downloads of individual lesson plans. The most popular of these, "Let's Make Poop" and "Mindfulness Jars," received 98 and 83 downloads, respectively. Similarly, videos about stress ("Address That Stress") and nutrition ("From Chew to Poo") on the CRI website were viewed 460 and 750 times, respectively, indicating that site visitors found the video resources to be useful supplements to Discover SCIENCE activities.

With the passage of time, more bilingual content was incorporated into the curriculum. Observations conducted during Year 1 made it clear that in order to effectively serve its target audience, Discover SCIENCE would need to develop materials in both English and Spanish. Drawing attention to the way that language barriers were interfering with programming efforts, one DCPL worker told us that "*the people who are there with the children maybe aren't literate in English—they can speak it just fine but can't necessarily read it.*" Statements like this led Knology to advise CRI staff to adapt Discover SCIENCE modules for ESOL learners and Spanish speakers. Significant progress in this direction was made, and now, parts of the curriculum are effectively bilingual, as can be seen in the website's "Staying Safe with Drew and Nia" videos, which teach children about germs, mucus, sleep, blood, the digestive system, and stress in both English and Spanish. As a result of these improvements, the Discover SCIENCE curriculum is now something that can be taught either in-person or in virtual settings, in English or Spanish, and by educators in many different OST contexts all across the country as part of their STEM or health programming.

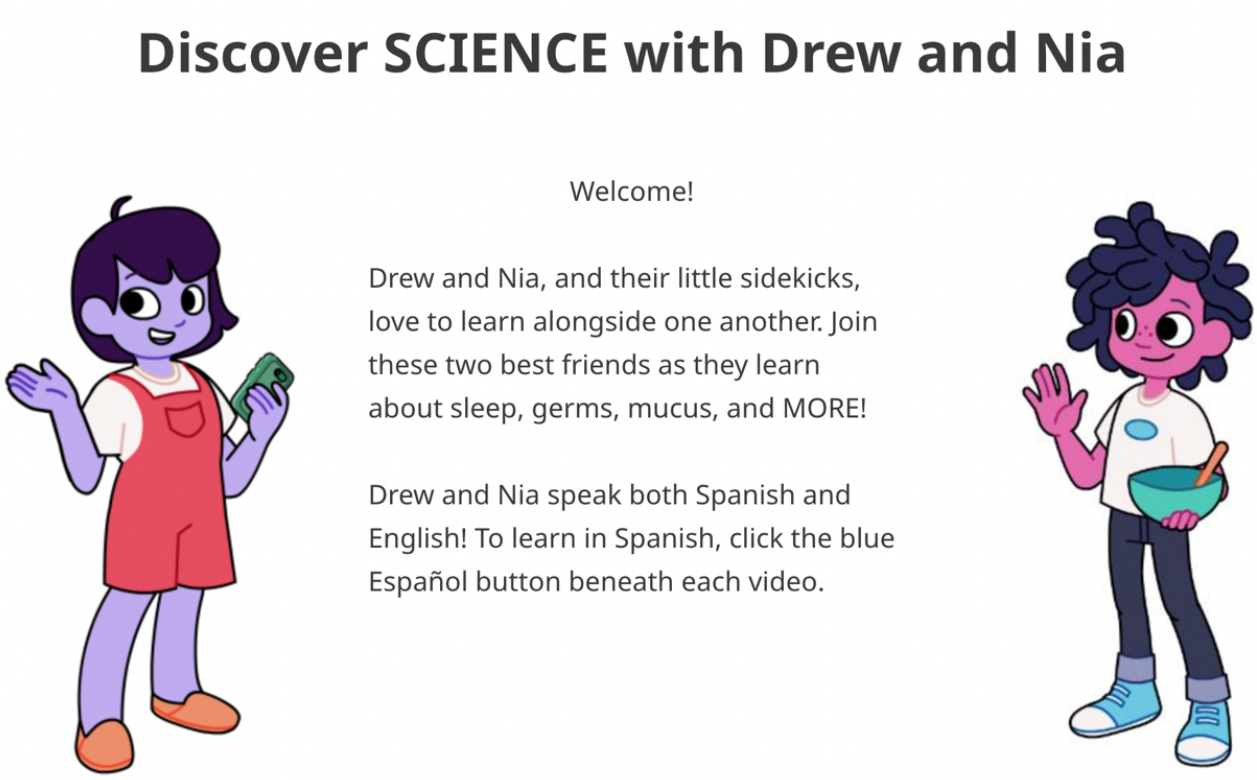


Figure 12. Bilingual video content from the Discover SCIENCE website

English/Inglés Spanish/Español

Figure 13. A Discover SCIENCE video on stress, in both English and Spanish

Thematic Findings: Learner Outcomes

A key aim of the Discover SCIENCE project was to provide children with positive STEM and health experiences—experiences that improved their knowledge of science and medicine, strengthened their critical thinking skills, encouraged interest in and identification with scientific and biomedical careers, and promoted healthy, active lifestyles.

To what extent did the project meet these goals? Did youth find the content engaging? Did the curriculum increase their scientific and health-related literacy? Did it strengthen their critical/creative thinking, reasoning, and problem-solving skills? Did the project foster excitement about STEM/biomedicine, STEM or health-related careers, and disease prevention efforts? And did it encourage children to adopt healthy habits?

Our evaluation showed that the project generated a high degree of interest among children, facilitated STEM and health learning, promoted positive identifications with science, and hastened the adoption of healthy, active lifestyles. In what follows, we substantiate each of the above findings, drawing on data collected across a range of sites over the course of the project's five-year history.

Finding #1: Children found the curriculum incredibly engaging

Evaluation results show that children's experiences of Discover SCIENCE were overwhelmingly positive. Within DCPL settings, youth were enthusiastically involved in all activities, needing no prompting from parents/caregivers or facilitators and often revisiting stations they found particularly enjoyable. Observers noted children smiling and talking excitedly throughout the lessons. Demonstrations were frequently met with exclamations such as "wow" or "oh my goodness." At the conclusion of a module, youth excitedly shared the knowledge they acquired and the items they created with peers, siblings, and caregivers—the latter of whom were often overheard discussing how much their children enjoyed the programming.

Part of what made the curriculum so engaging was the way it encouraged learning through hands-on play. Speaking to this, one facilitator who taught a lesson on bones noted how excited children were to play with the different materials used to construct a mock human skeleton. Even after finishing this activity, they continued talking about the different bones and muscles in the human body, all while proudly showing off their creations.

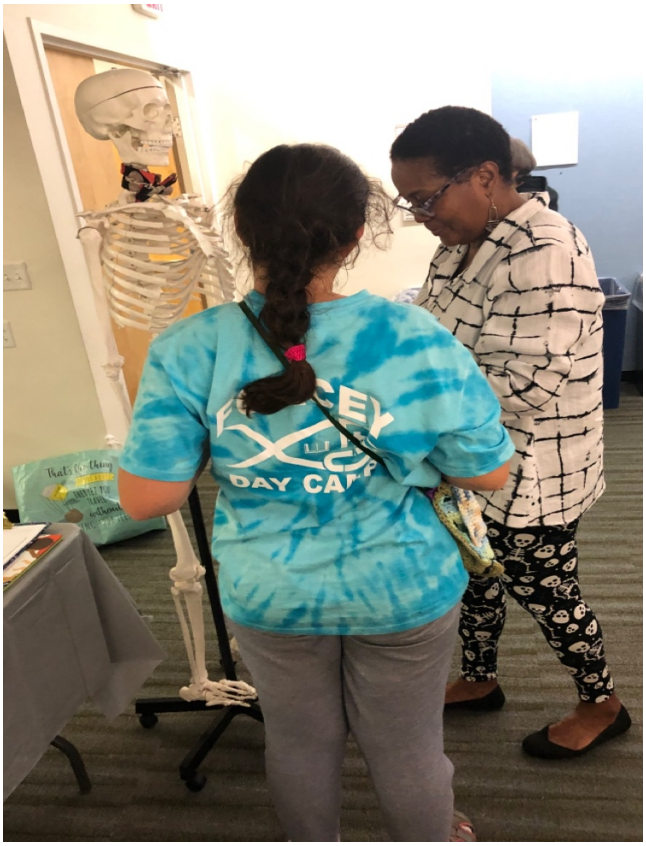


Figure 14. Children completing an activity as part of the "Bone Zone" module

Girl Scout leaders reported similar levels of excitement and enthusiasm among troop members. On one occasion, a troop leader observed that after finishing a series of Discover SCIENCE activities, "*we had a meeting when the girls were like 'so what's our next activity?' and they were bummed when we had to do a Valentine's Day activity instead*." When asked about a module focused on COVID-19, a colleague reported that "*my high schoolers loved making blood vessels, blood cells, and models of viruses and vaccines as much as my little ones did*."

While some of the evidence we acquired is anecdotal, quantitative indicators also serve to underscore the feelings of joy and excitement children experienced during Discover SCIENCE programs. For example, when asked to respond to the prompt "*I had fun at camp*," 15 of 17 campers who participated in the Summer Science experience chose a "very happy face" emoticon. Similarly, at the conclusion of this program, 14 of 17 chose this emoticon in response to the prompt "*I want to come back next year*."

Without a doubt, the onset of the COVID-19 pandemic made it difficult to sustain these feelings of joy and excitement. After Year 2, there were no more Summer Science Camps. During Year 3 of the project, GSGNY leaders observed that keeping girls engaged during virtual sessions was sometimes a very trying matter. As one leader put it, "*transitioning to online, it is hard to keep Scouts engaged, and to work with parents to help kids stay involved and have something to do*." Nevertheless, the pandemic failed to dampen children's' enthusiasm for Discover SCIENCE. As one troop leader explained, virtual programming "*has a lot of creativity and possibility*," and once adapted for online delivery, most activities continued to pique learners' curiosities and interest. Those who returned to

in-person activities during Year 5 of the project reported similar findings. As one facilitator put it, the youth who participated in Discover SCIENCE demonstrated a newfound "*love of learning and love of science*."

Finding #2: Children became familiar with a number of new STEM and health-related concepts, and strengthened their critical thinking skills

Our evaluation of the curriculum's implementation demonstrated that Discover SCIENCE facilitated children's intellectual growth in myriad ways. While Knology undertook no systematic assessment of children's knowledge levels at the project's outset, both our observations and our conversations with facilitators and caregivers revealed clear evidence of health and science-related learning. While attending DCPL sessions in Year 1, we saw that children with little pre-existing knowledge of the topics under investigation acquired not only new vocabulary, but also an ability to talk about their bodies and the natural world in more scientifically accurate ways. For example, though youth who participated in the "From Fork to Stomach" lesson initially used incorrect terms like "stomach" or "tummy" to talk about the intestines, their completion of this module gave them mastery over both a new anatomical term and the workings of the digestive system. Similarly, though children at the Summer Science camp initially told teen mentors things like "*I don't know how to build a robot*," brainstorming activities generated both excitement and skills acquisition—so much that learners were reluctant to rotate away from the station.

Facilitators also observed gains in knowledge. At times, this was difficult to gauge. Speaking to the difficulties involved in tracking children's learning, one DCPL staff member told us that "*we just give them the information and hope it sticks*." But most facilitators saw clear evidence of increasing scientific literacy. At the beginning of a new day's activities, they typically asked youth to recall what they had learned during a previous lesson. Children generally succeeded in answering these questions. For example, at one particular DCPL session, youth who had created bracelets during the "The Nose Knows" lesson correctly defined a number of asthma triggers, including allergies. Similarly, several Girl Scout leaders noted how after "*asking girls to recap what they learned last week for girls that were absent*," most troops had no difficulty summarizing the contents of previous lessons. Facilitators also observed gains in health literacy when learners shared information about friends or family members who had experienced some of the symptoms associated with the particular medical conditions they learned about.

Perhaps some of the clearest evidence of active learning could be seen through observations of peer interactions. After finishing a given activity, youth who attended DCPL sessions were frequently seen instructing friends and siblings on how to complete it. When moving to a new station, they frequently shared what they had learned previously with other facilitators. Girl Scouts leaders reported similar behaviors by their troops. One described how they occasionally overheard conversations in which troops discussed the contents of individual lessons. "*Sometimes it just happens randomly*," she told us, "*and I hear them just*

talking about it." Often, these impromptu conversations resulted in new discoveries and more in-depth knowledge of a topic. For example, when commenting on the DNA bracelet lesson, one Girl Scout leader recalled how learning about the similarities between human and cabbage DNA prompted girls to "*start looking up other things we share DNA with, which led us to a great conversation*."

Frequently, older troop members shared knowledge with their younger counterparts. In our interviews, four leaders with mixed-age groups reported watching the older girls teach the younger troop members—firsthand evidence of the older girls' mastery of the Discover SCIENCE curriculum. In addition to building scientific literacy, allowing older troops to become facilitators yielded gains in leadership skills. As one leader told us: "*I left [decision-making] up to the older girls who had become slime experts and added food coloring. It was amazing when I let them take over what they wanted to do*." Through taking on mentorship roles, older youth created opportunities for troop-led work, and confidently shared detailed information with younger cohorts.

They also shared this knowledge with caregivers. Pointing to this, one troop leader noted how "*the fun fact sheet was great—the girls love showing off what they learned to their parents*." For their part, caregivers also reported on how the curriculum gave learners a better understanding of health, science, and the human body. Speaking about a DCPL module that dealt with brain injuries, one caregiver told us that the lesson was "*reinforcing what I'm teaching*."

The curriculum also deepened children's critical thinking capacities. Highlighting the ways that children began to make use of lesson vocabulary and concepts in their conversations, one library worker remarked on how "*they made some really cool connections*," adding that the activities stimulated "*some really interesting problem-solving*." After leading children through the "Socktopus" activity, another facilitator reported that this exercise prompted all kinds of critical thinking about why humans dream, and what our dreams might mean for our waking lives.

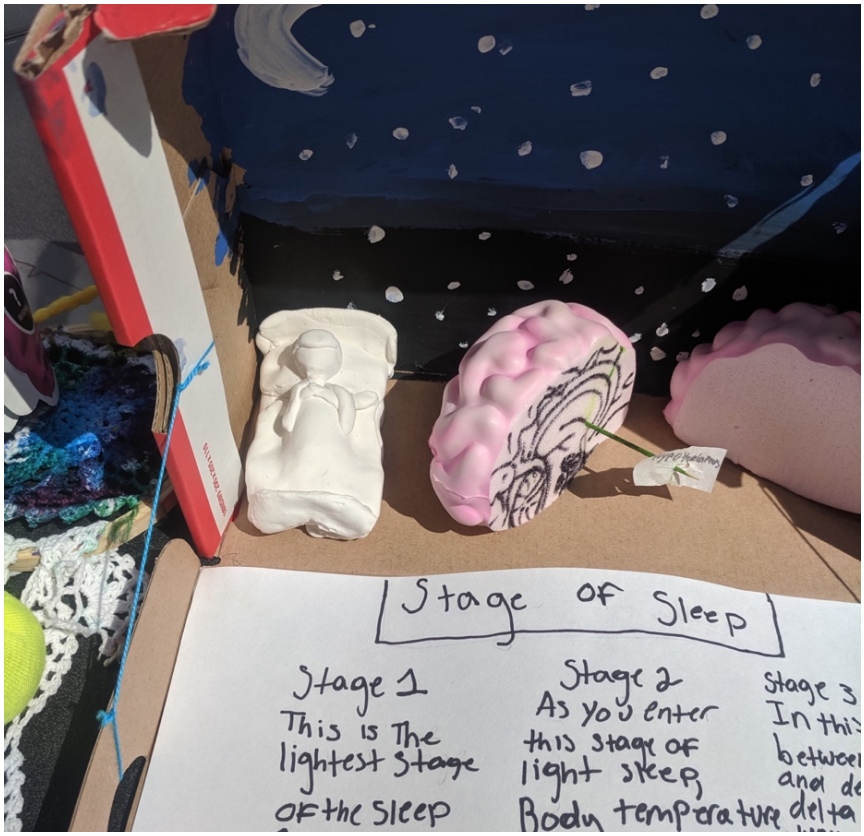


Figure 15. A camper illustrates the different stages of sleep

Finding #3: Children learned about a variety of STEM and health-related careers

While many of the youth that came to Discover SCIENCE already had an interest in science and health, their appreciation and identification with STEM and health-related fields and career paths was clearly strengthened by participation in the program. Some of the most powerful evidence of this can be seen through our evaluation of the Summer Science camp, where children were regularly asked to sketch images of scientists. On the first day of camp, most of their drawings reflected popular attitudes as to the kinds of people who pursue scientific careers—for example, "Science Bob," an old man in a lab coat with unkempt hair. But as they interacted with professional scientists, these stereotypes broke down. For example, after hearing a presentation delivered by a NASA scientist, one camper voiced a desire to become the next Black woman astronaut. By the end of the week, many campers were drawing illustrations that looked very much like themselves. And when asked if going to camp made them want to become scientists, most responded affirmatively, listing a number of specific fields (including anesthesiology, astronomy, geology, marine biology, medicine, paleontology, and zoology) as potential career options.

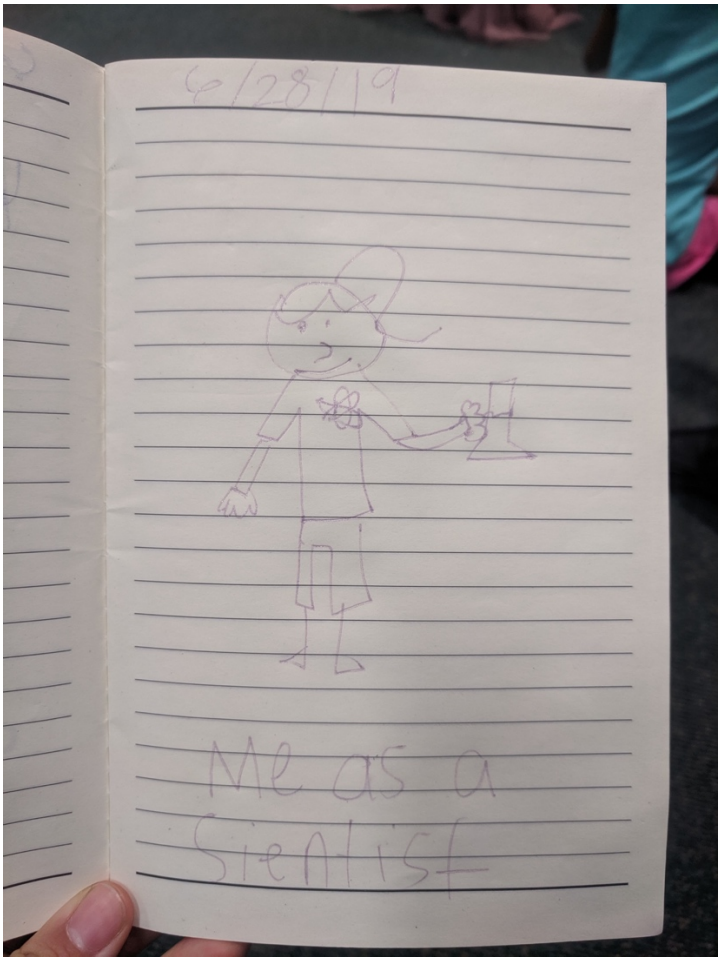


Figure 16. A camper depicts themself as a scientist

Girl Scout leaders also informed us that Discover SCIENCE programming had helped troops developed a new, more positive science identity. As one leader put it, Discover SCIENCE

> *"Gave them an opportunity to show their 'nerd girl' sides, their science sides, you know. Not the craftiness, not the social butterfly parts, but the parts where they learn things, and they're proud to know things and have this knowledge that sets them apart and makes them these little science experts."*

In a very similar vein, another Girl Scouts leader told us that Discover SCIENCE was "*a really great program*." "*I think it does pique the girls' interest to see that science is not unapproachable and it's fun and it can be a little messy*," she added, explaining that "*it's a really good gateway into science for girls. So, kudos on that*." Within GSGNY, the consensus among facilitators was that Discover SCIENCE powerfully affected Girl Scouts' identities. As one told us, girls were "*proud ... to have this knowledge that sets them apart and makes them little science experts*."

Finding #4: Children learned about the importance of active, healthy lifestyles

A key aim of the Discover SCIENCE curriculum was to advance pediatric health. In addition to making youth more scientifically literate and more interested in STEM and health-related careers, project leaders sought to encourage children to take up more active, healthy lifestyles.

From its inception, project participants noted the difficulties involved in getting children to adopt active, healthy lifestyles in places where patterns of racial segregation and socioeconomic disenfranchisement have combined to produce extensive food desserts. As a library worker explained to us during the first year of the project:

> *"If you are doing a nutrition piece program, be conscious of if there are families in the room. Are they in a neighborhood where they need to walk two miles to get to the nearest grocery store that has fresh fruits and vegetables?"*

As the project unfolded, we had ample opportunity to witness these structural barriers. Most notably, during DCPL programming, we sometimes observed children consuming junk food and soda while completing activities. The availability of such foods in library settings undercut one of the key goals of the programs, just as the use of plastic water bottles (even when drinking fountains were present) countered efforts to advance children's knowledge of the relationship between bodily health, disease, and the environment. Overcoming such barriers to healthy living proved difficult; as library staff told us, sanitary precautions prevent them from providing fresh fruit or other healthier snacks to children.

From the earliest days of Discover SCIENCE, CRI staff were aware of these difficulties. Cognizant of the fact that many DC residents lack access to health, affordable food, and that many of the children they were working with faced food security challenges (including lack of choice in free or reduced lunch options at school), they tailored the curriculum's nutrition modules in ways that reflected local needs and circumstances. Although early iterations of the curriculum recommended that facilitators ask questions about diet (e.g., "*how do you know if a diet is balanced?*"), this material was quickly phased out in favor of activities that highlighted the process of digestion, and on how different foods break down and impact the body. Along with this, project leadership created a guidebook that included resources for talking to children about diet culture. Stressing the dangers of labeling any food as "good" or "bad," these resources included links to articles and activities designed to promote body positivity. Such changes helped ensure that all children could relate to and learn from the curriculum's nutrition module.

These resources helped facilitators promote healthy behaviors in a variety of ways. For example, in lessons devoted to nutrition, they asked questions about diet and encouraged children to list their favorite types of exercise. Some DCPL programs included yoga sessions, and during Girl Scout meetings, leaders encouraged troops to translate what they had learned into physical activities.

Such activities produced tangible behavioral gains. For example, after learning about respiratory function, one Girl Scout leader said they "*talked to the girls about running and how you need to protect your lungs, and I could see them put one and one together. They were able to incorporate it into their day-to-day life*." Another example occurred with a separate troop who went on an in-person hike and carried water in bottle holders assembled through the "It's Great to Hydrate" lesson. The troop leader continued the conversation about hydration into separate activities not specific to Discover SCIENCE.

Available evidence also suggests that campers who participated in the Summer Science program were practicing healthy habits to a greater extent than previously. Several campers mentioned that their experiences had impressed upon them the value of a full night's sleep, regular body scanning, and learning about bodily functions. In addition to this, mentors noted that youth acquired skills of a social and emotional sort—for example, teamwork, confidence, and maturity.

Thematic Findings: Facilitator Outcomes

One of the key goals of the Discover SCIENCE project was to create professional development and training opportunities for library workers and educators working in informal learning settings. These efforts commenced in Year 2, and expanded into both in-person and virtual settings during Year 3. Their aims for educators and facilitators were threefold: (1) provide content-related knowledge; (2) strengthen pedagogical skills; and (3) build up confidence in teaching on STEM and health-related topics.

How effective were these efforts? Did the project contribute to OST educators' professional development? Did library professionals and other educators working in informal learning settings receive training on how to conduct STEM and health activities in libraries and other out-of-school settings, and if so, what were the results of these sessions? Did it equip OST facilitators with the knowledge, tools, and skills needed to implement the Discover SCIENCE curriculum? And did the launching of professional development and trainings help create a learning community among project partners?

Our evaluation revealed that training and professional development activities made facilitators more knowledgeable about a variety of STEM and health topics, enhanced their pedagogical skills, and made them more confident to teach the Discover SCIENCE curriculum. In what follows, we substantiate each of the above findings, drawing on data collected across a range of sites over the course of the project's five-year history.

Finding #1: Facilitators became more knowledgeable on a range of STEM and health-related topics

Data collected during the project's first year illustrated how important facilitator training would be to the success of Discover SCIENCE. During a DCPL focus group meeting, most library workers indicated that they had no previous experience with health- or science-related programming. One library worker predicted that colleagues without a background in STEM/health might be reluctant to administer the curriculum:

> *"As far as having the librarians be the leaders and not someone who has a health background, that adds an extra layer of something I have to learn…that can be an extra barrier for me. If I don't know that [topic], I don't want to put that program on…I want to have enough [knowledge] that if someone asked a question, I could address it with more than 'oh, I don't know, I will have to go look that up.' That can just be one more thing for me to have to do for prep work."*

Voicing similar sentiments, a colleague suggested that library staff might feel more capable of implementing the curriculum if they started out in a supportive role, learning by observing CRI staff direct individual modules.

Figure 17 below highlights responses to a survey administered to 32 facilitators during Years 4 and 5. As this shows, library staff consistently reported that professional development or training sessions made them more knowledgeable about the various topics covered within the curriculum. Those with a background in STEM/health appreciated the way training sessions served as useful "*refresher courses*," while those lacking this background reported that the information relayed by CRI staff made Discover SCIENCE lessons *"easy to implement."* DCPL staff came away from training exercises confident in their ability to address questions that learners might have about the scientific content in particular lessons. Similarly, after completing their training modules, GSGNY leaders reported gains in STEM and health-related knowledge. Whether provided on site or virtually, lesson plan overviews provided troop leaders with all of the information needed to present on the various topics contained within the curriculum. As one told us, "*the girls ask questions about everything… so you need to be prepared to answer anything*."

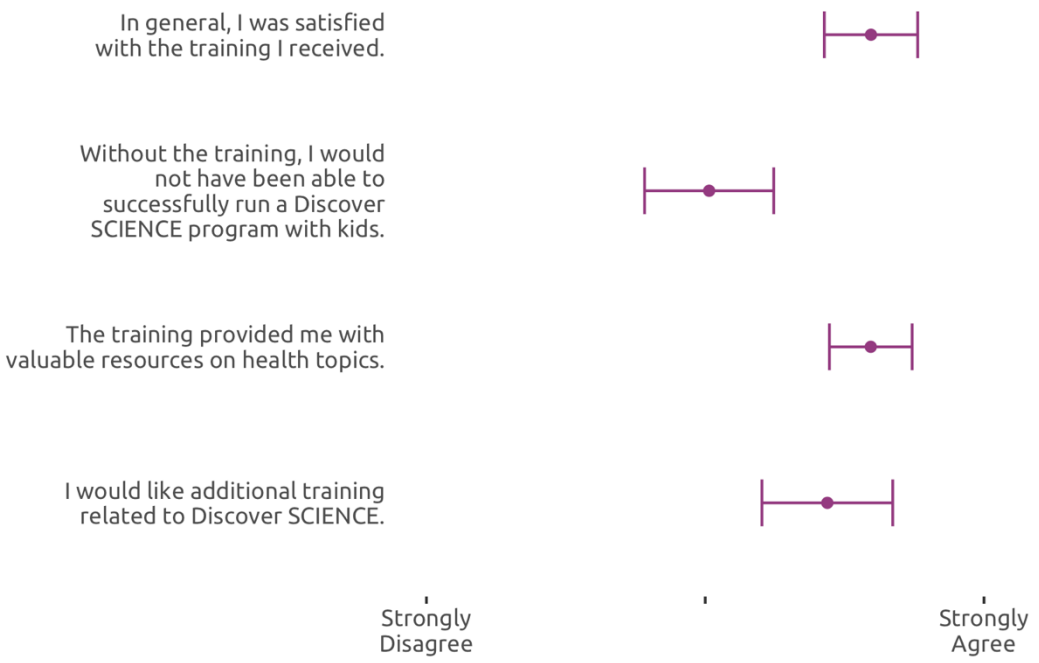
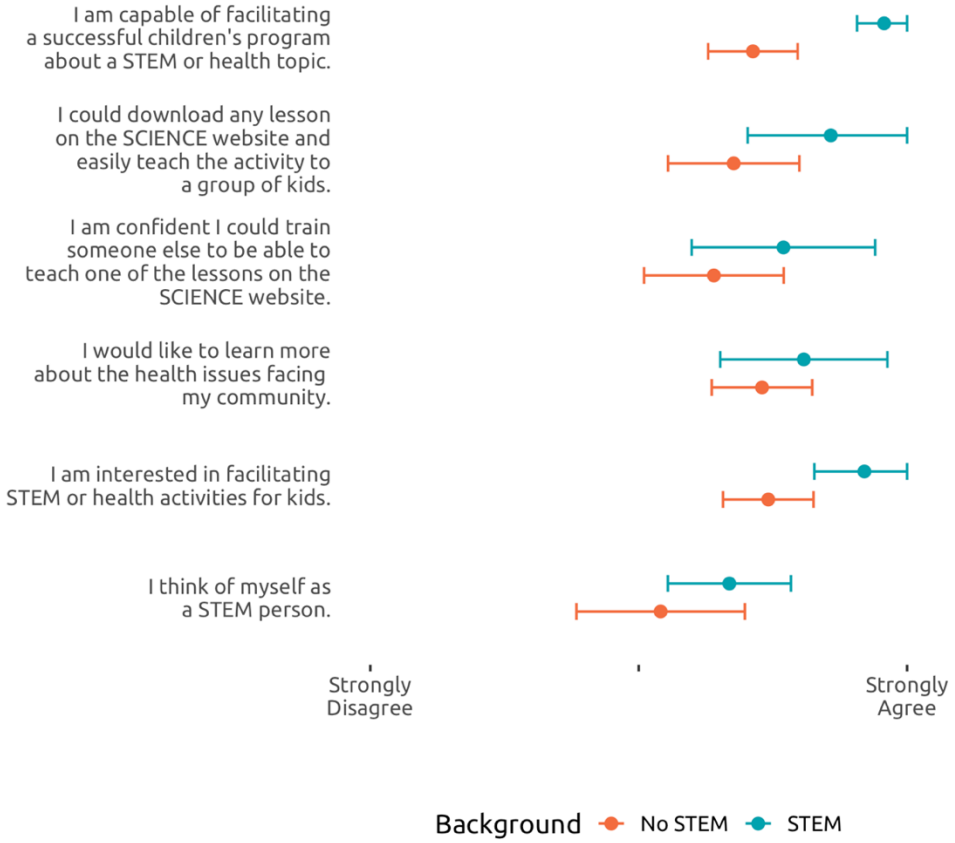


Figure 17. Responses to a Discover SCIENCE orientation/training survey, Years 4 and 5.

Note. The points above indicate mean values, while the whiskers indicate confidence intervals.

Finding #2: Facilitators became more confident STEM and health educators

At the same time, facilitators appreciated how the training emphasized their status as non-experts—that is, as co-learners who would discover and learn things with children. This worked to increase their confidence in delivering the curriculum, something that one DCPL library worker drew attention to when explaining how the training made them feel "*at ease to approach questions that may arise from participants as a fellow learner*." Echoing this, a Girl Scouts leader informed us that "*if there was any confusion, I would just refer to the handbook. After each class I photocopied the talking points and gave them to the girls to take home and tell their parents what they had learned*." While some facilitators initially felt unqualified to teach the Discover SCIENCE curriculum, these fears receded as they acquired



more and more knowledge of STEM or health-related topics, and as the Discover SCIENCE built out the resources on the website, including the accompanying handbook of lessons and activities. As one library worker expressed it, "*maybe we were not as confident about the health content and sometimes doubted ourselves when really we did have all the skills*."

Figure 18. Responses to a Discover SCIENCE orientation/training survey, Years 4 and 5. Points indicate mean values, while whiskers indicate confidence intervals.

This was as true of facilitators who participated in virtual training sessions as it was for those who took part in in-person orientations. One respondent informed us that even though many people claim to "*hate virtual training*," CRI staff were very enthusiastic during these

sessions—so much so that some educators expressed a desire to return for a second round of training. Even when meeting via Zoom, the ability to interact with "*really knowledgeable*" trainers was much appreciated and helped facilitators feel confident and comfortable leading exercises. Many also appreciated the accessibility of online orientations, as some educators lacked their own form of transportation. Figure 18 presents more results from a survey administered to facilitators during Years 4 and 5. Regardless of prior STEM or health knowledge, respondents indicated a high degree of confidence in teaching the curriculum after completing training or orientation sessions.

Finding #3: Facilitators acquired more pedagogical know-how

Another thing that made the training sessions useful was the way they provided opportunities for sharpening facilitators' pedagogical skills. As one respondent put it, what made orientation "*fantastic*" was not just CRI staff's ability to make him "*feel welcome*," but also, the fact that the Discover SCIENCE team was "*very forthcoming with the instructions*" for individual lesson plans. These instructions successfully equipped facilitators with a knowledge of how to better engage young learners.

One Girl Scouts leader told us that having an opportunity to brainstorm and share ideas with colleagues was incredibly helpful since they "*had other perspectives that we could use to disseminate [activities] to the girls and share them in a different or better way*." Through these exchanges, facilitators not only learned how to implement the curriculum more effectively, but also succeeded in creating a broader learning community.

Finding #4: Facilitators deepened ties with colleagues and communities

Facilitators frequently commented on how training sessions and professional development programs allowed them to strengthen ties with colleagues and communities. DCPL library staff said they valued the opportunity to learn more about the health-related challenges confronting the DC metro area, and appreciated discussions focused on equity and health disparities. As one put it, "*I work in an underserved community and this showed me what I can do as a librarian*." Along similar lines, a co-worker observed that the "*whole process was enlightening and challenged me to see how I can use this information and give it back to the people I work with*." In addition to this, library workers looked forward to sharing what they had learned with colleagues and came away from professional development programs and training sessions committed anew to helping children learn more about the important health issues facing their communities.

Thematic Findings: Other Target Audiences

In addition to making children and facilitators more knowledgeable about a wide range of STEM and health topics, a core goal of Discover SCIENCE was to create a more general culture of STEM and health learning, one that spanned multiple generations and included those without direct exposure to the project.

To what extent did Discover SCIENCE meet this goal? Did children's friends, parents, siblings, and/or caregivers benefit from the curriculum? Did facilitators' colleagues become more familiar with the principles of effective STEM and health programming? How successful was the project in creating a learning community among partners?

Finding #1: Discover SCIENCE developed methods and tools for creating an intergenerational culture of STEM and health learning

From the earliest days of the project, caregivers gained significant exposure to Discover SCIENCE. When present at DCPL sessions, facilitators encouraged caregivers to make use of take-home activities, and to engage children in at-home discussions related to the topic of the day's lesson. Some responded favorably to these overtures. However, few caregivers participated in Discover SCIENCE activities, and at times, those who did sometimes did in a counterproductive fashion—for example, becoming frustrated with their children or focusing on mediating disputes between siblings rather than redirecting efforts toward a learning opportunity. Some caregivers failed to grasp intended program objectives.

That is not to say that caregivers derived no benefits from children's participation in Discover SCIENCE. While our evaluations revealed no direct evidence of lessons being repeated at home, youth often shared things they learned with caregivers, while also presenting them with some of the crafts created at different learning stations. One parent noted how the things her child learned about brain injuries were "*reinforcing what I'm teaching [at home]*." And in an observation suggesting that Discover SCIENCE did stimulate processes of intergenerational learning, a Girl Scout leader conveyed the following about a session on DNA and blood types:

> *"They left with having questions at the end of it – asking their mom about their blood type, and raising awareness of how women can also have heart problems. And I think that was the best thing for me. At the end of the day, I left them with a question to ask their parents."*

With the shift to virtual programming, some caregivers became more involved in Discover SCIENCE activities. One GSGNY leader reported that parents/caregivers were so eager to participate in these activities that she had to devise techniques for keeping them from "*jumping in too much.*" Of course, the pandemic also presented obstacles to parental involvement. As another Girl Scouts leader explained, "*most parents are essential workers so it's hard to make sure everyone is home and safe AND engaged with what we can offer*."

Figure 19. A "Home Safety Challenge" poster

In addition to drawing older generations into STEM learning, children eagerly shared what they learned with friends and classmates. During one of our interviews, a Girl Scouts leader discussed how their troops made extra DNA bracelets to give out to friends at school. The deliveries came with a mini-lesson on DNA, that they reported as "*good feedback because we saw kids at school wearing bracelets and we knew where it came from. They love having a keepsake*." Another leader reported that several girls talked about obtaining copies of the books attached to the several different lesson plans' recommended reading lists.

Lastly, those facilitators who took part in training sessions and professional development activities often reported on how their experiences encouraged them to share what they had learned with co-workers and community members. As on DCPL staff member observed, the "*whole process was enlightening and challenged me to see how I can use this information and give it back to the people I work with*." Others agreed that the information sessions were relevant to their broader work as library professionals, and reported feeling empowered and filled with new purpose as a result of their training. One library worker found that professional development activities served as a valuable reminder as to the at-times invisible health-related difficulties confronting many library patrons.

Figure 20. Informational packets distributed to caregivers and families

Discussion

Discover SCIENCE was created in response to the problem that is the severe under-representation of racial minorities in the STEM and health professions. Informed by a body of scholarship highlighting how critical positive early childhood experiences are to the pursuit of scientific and biomedical careers, it sought to contribute to the creation of a more diverse, racially inclusive STEM and health workforce by improving African American, African, and Hispanic youth's access to high-quality STEM learning. Specifically targeting children in high-poverty communities, where schools are often under-resourced and face difficulties equipping learners for success in science and medicine, Discover SCIENCE brought STEM and health learning out of the classroom, and into a variety of different out-of-school time (OST) contexts. Through partnerships with public libraries in the Washington, D.C. and Baltimore metro areas, along with a variety of other organizations across the country, the project's hands-on, arts-focused curriculum focused squarely on the health disparities most often seen in high-poverty communities, and sought to help children learn about these in a way that would both advance the goals of pediatric health and create new pathways for entry into STEM and health-related fields.

In pursuit of these broad goals, Discover SCIENCE had four key aims:

- Expose learners to the fundamental interaction between the environment, health, and disease prevention through exposure to scientific thinking, asking, and answering questions, and gathering and assessing data;
- Meet Next Generation Science Standards (NGSS), Common Core State Standards (CCSS), and local and other evolving national standards using art and manipulation to further scientific and health concepts;
- Ensure that computation, imaging, and engineering constructs are intrinsic to each module; and
- Evaluate effectiveness and continuously improve programming through external evaluation.

Achieving these aims would help Discover SCIENCE advance two important societal missions: (1) reducing the achievement gap among low-income youth; (2) reducing those health disparities borne of systemic racism and socioeconomic disadvantage.

To measure progress toward each of the above aims, our evaluation highlighted three key impact areas: ***knowledge***, ***attitudes***, and ***behavior***. In terms of knowledge, we asked whether Discover SCIENCE ***increased children's STEM and health-related literacy skills***, and if it helped ***build a culture of shared learning*** among children and their families. We also asked if the project gave facilitators the knowledge and skills required to implement the curriculum. To consider impact on attitudes, we examined whether Discover SCIENCE ***fostered excitement about health and STEM and health-related careers*** among children, and if the project gave facilitators confidence teaching on STEM and health-related topics. Lastly, we looked at whether Discover SCIENCE ***promoted healthy and active lifestyle*** behaviors among children and their peers, siblings, and parents/caregivers.

After five years of evaluation, Knology has determined that Discover SCIENCE succeeded in creating an effective new model for K–5 STEM and health instruction, and in disseminating this into a variety of different out-of-school-time (OST) contexts. Through direct observation of the curriculum's implementation and in-depth interactions with the project's many participants, we conclude that Discover SCIENCE was successful in its attempts to bring STEM and health learning out of the classroom and into community-based settings. Wherever Discover SCIENCE programming took place, children engaged the curriculum with enthusiasm and excitement, and as our evidence demonstrated, the project not only increased children's familiarity with a wide range of STEM and health-related concepts, but also stimulated their critical thinking faculties. Beyond this, Discover SCIENCE generated newfound awareness of and interest in STEM and health-related careers, and in the pursuit of those individual habits linked to disease prevention and healthy living. These effects reverberated beyond individual program sites, and speak well of Discover SCIENCE's prospects for supporting cultures of STEM and health learning that encompass children's peers, families, support groups, and the broader community.

Our assessment revealed that Discover SCIENCE successfully created a network of library professionals and educators working in informal learning settings who are capable of delivering high-quality STEM and health learning opportunities to children. Whether it be through informal training sessions or formal professional development programs, CRI staff developed an effective mechanism for ensuring that those in charge of the curriculum's implementation possess all of the content-related knowledge and pedagogical tools required to increase young learners' STEM and health-related literacy levels, and to encourage the adoption of healthy, active lifestyles. Though feedback from facilitators pointed to several potential barriers to effective programming, over the course of the project, most of these were successfully overcome. With the passage of time, the Discover SCIENCE curriculum steadily expanded, as did the range and diversity of its audiences. Between Year 1 and Year 5, the curriculum became more accessible, allowing for participation among both English and Spanish speakers and for use within both in-person and virtual environments.

In its present state, the Discover SCIENCE project is a successful organization of materials and resources, all of which can be used by educators to promote cultures of STEM and health learning and success among children lacking access to the kinds of educational content needed to develop scientific literacy, to promote interest in STEM and health-related careers, and to advance pediatric health.

Conclusion

Children living in high-poverty communities often lack access to high-quality education in STEM and health-related subjects. Historically, this lack of access has worked both to perpetuate poor health outcomes and to bar the entrance of economically marginalized peoples into the STEM and health-related professions. Taking aim at both of these deficiencies, the Discover SCIENCE project pioneered a new form of STEM and health-related learning, one situated in out-of-school time (OST) contexts such as libraries and other community-based sites. Armed with an interactive, hands-on, art-based curriculum, between 2017 and 2022, team leaders brought Discover SCIENCE to hundreds of children—including the siblings, friends, and peers of those who directly participated in the project. Our assessment revealed that Discover SCIENCE helped young learners become more knowledgeable about science, medicine, and health. The project also fostered enthusiasm for about STEM and health-related careers, and helped children realize the importance of healthy habits and active lifestyles. These findings indicate that the Discover SCIENCE curriculum is well-positioned to help build more inclusive pathways to STEM and health education, and to help break down those barriers that have long barred the entry of racial minorities, girls, and other marginalized groups into STEM and health-related professions.

Discover SCIENCE also succeeded in creating a new class of informal STEM and health educators. The pedagogical resources developed by project leadership have made it possible for a variety of educators working in informal learning settings (including those without backgrounds in science and medicine) to teach the Discover SCIENCE curriculum in a variety of different OST settings. Now available for use within the home, inside classrooms, and in a number of different cultural institutions, Discover SCIENCE has the potential to create an intergenerational culture of health learning—one that benefits not only children, but also, their siblings, friends, peers, families, and the communities they live in more generally. Given this, Discover SCIENCE is well positioned as a tool for closing achievement gaps among low-income youth, and for helping reduce those health disparities borne of racism and socioeconomic dispossession.

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