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**INSIDE: THE EMOTION-BASED MUSEUM EXPERIENCE**

PLUS: STEM IN LIBRARIES, NAVIGATING CHANGE IN THE  
21ST CENTURY, AND MORE!

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## LESSONS LEARNED FROM A DECADE OF STEM EXHIBITIONS IN LIBRARIES

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### THE STEM LEARNING MOVEMENT IN PUBLIC LIBRARIES

This paper examines the evolution of STEM programs in the public library sector through the lens of the Space Science Institute's STAR Library Network (STAR Net) from 2010-2019. STAR Net focuses on helping library professionals build their STEM skills by providing "science-technology activities and resources" (STAR) and training to use those resources. Over 8,000 library and STEM professionals have joined STAR Net's community of practice (CoP) to access webinar trainings, monthly newsletters, professional blogs, partnership opportunities, facilitation guides, and take

advantage of its STEM Activity Clearinghouse resources. A hallmark of STAR Net has been the development and tour of several museum-quality STEM exhibitions that were hosted by libraries nationwide (described in Section 3). Key partners include the American Library Association (ALA), Lunar and Planetary Institute (LPI), Afterschool Alliance, and Education Development Center (EDC).

Building the capacity of public libraries and library staff to deliver engaging, inspirational, and educational STEM programs has the potential to transform the STEM educa



Figure 1: Discover Tech Exhibit. Credit: Ypsilanti District Library and Afterschool Alliance.

tion landscape across the country. What started in libraries some years ago as independent experiments in STEM programming has become a national STEM education movement (Dusenbery, 2014a; Shtivelband et al., 2017).

Public libraries serve people of all races, ages, and socio-economic backgrounds and are re-envisioning their mission and role in the community (Dusenbery, 2014a; Shtivelband et al., 2016). Baek (2013a) observed that libraries could become “on-ramps” to STEM learning by creating environments that welcome newcomers to the community. In 2013, the Pew Research Center (PRC) conducted a survey of over 6,200 Americans to learn about how people utilized public library services. This study found that 91% of Americans ages 16 and older say public libraries are important to their communities and are an important educational resource and 76% say libraries are important to them and their families. African Americans (60%) and Hispanics (55%) are more likely to say that libraries are “very important” to them and their families compared to Caucasian families (41%).

Communities increasingly value their public library as a hub for lifelong learning, and library programs and services continue to evolve to meet the needs of diverse learners, including in STEM (ALA, 2018). In 2016, there were 1.4 billion in-person visits to the 16,560 public libraries and 647 bookmobiles in the U.S. (IMLS, 2018). This is equivalent to about 4 million visits each day. Public programming expanded 17% since FY2012 (Reid, 2017); in 2016, public libraries offered 4.70 million programs across all age bands and on a variety of topics, which were attended by over 113 million people (IMLS, 2018). A recent Gallup poll (Gallup, 2019) found that “visiting the library remains the most common cultural activity Americans engage in” far surpassing going to a movie theater or live sporting events. The poll also found that women were almost twice as likely

to visit a library as men and low-income Americans visited more often than those with higher incomes.

STEM disciplines and careers are an increasing focus of public library programs and services (Baek, 2013a; Hakala et al., 2016; LaConte & Dusenbery, 2016; LaConte et al., 2016). Public libraries hold great promise for promoting STEM education and learning (Dusenbery, 2014a; Shtivelband et al., 2016; Gilbert et al., 2019). These informal, free-choice institutions (NRC, 2009) are creating maker-spaces, hosting STEM exhibits, and offering hands-on STEM programming (Dusenbery 2014b; Institute of Museum and Library Services [IMLS], 2018; LaConte et al., 2016). Libraries may be providing STEM programs on their own, or in partnership with other libraries, museums, businesses, and schools to educate and engage the public in STEM topics (Koester, 2013; National Research Council, 2015).

When the Space Science Institute initially surveyed libraries in 2008 (prior to STAR Net), many librarians did not feel comfortable conducting STEM programming, didn’t know that STEM exhibit opportunities were available to them (they were far more comfortable with history and literature subjects), and did not feel like they had received any instruction on how to implement a hands-on STEM program (Dusenbery, 2014a). A more recent survey in 2015 from Jim Hakala at the University of Colorado (Hakala et al., 2016) showed dramatic changes: only 14% of respondents did not offer STEM-rich learning experiences. 69% of respondents had conducted hands-on investigations, 51% had done art-based STEM projects, and 34% host informal STEM hubs known as makerspaces. Furthermore, 84% of respondents said that “science” would interest the library staff and patrons. In just a few years, libraries around the country have significantly shifted—and continue shifting—their practice towards STEM, which should not be surprising, as libraries have responded to community interest and needs that STEM learning can address.

The latest STAR Net library survey, reported by Shtivelband



Figure 2: Discover Space Exhibit. Credit: STAR Net/SSI.

et al. (2017), found that of the 717 responding libraries (49% of which were in rural/small communities), 75% offer STEM programming “more than once per month” or “monthly.” Most libraries surveyed (91%) were extremely interested or interested in offering more STEM programming, and 69% felt “ready” to offer STEM programs and activities to their patrons (see Section 4). Multiple reports demonstrate that library staff go far beyond the use of science-related books in their programming to hands-on activities, collaborative small-group work, and deliberate use of vocabulary and/or questioning strategies (Peterson 2017; YALSA 2018). The arts (including design) are often integrated into STEM (i.e., STEAM) to attract interest, especially for girls (Koester, 2013), and enhance creativity (Sousa & Pilecki, 2013). These approaches align with critical 21st century skills of teamwork, problem-solving, and self-reflection (NRC, 2015) as well as the recently published America’s Strategy for STEM Education (White House, 2018).

### STAR NET GOALS AND STRATEGY

*The Discover Space exhibit has opened the doors for us to our local community of STEM-learning organizations and we intend to work with these organizations to further and foster a love of [STEM] in all of our community!*

~STAR Net Librarian

The focus of this paper will be on the model developed by the STAR Net team during Phase 1 (2010-2015) and Phase 2 (2015-2019) that was funded by the National Science Foundation. Partners included ALA, LPI, Afterschool Alliance, and Research Evaluation Consulting. Education Development Center conducted the evaluations. The following goals for Phase 2 were similar to the ones we had for Phase 1. They guided project development and implementation and were the basis for the evaluation efforts in both Phases (see key results in Section 6).

**Goal 1. Increase youth and adult patrons’ interest, knowledge, and engagement in STEM topics** through innovative exhibits, programming, and resources with a focus on the vital role that STEM plays in our everyday lives.

**Goal 2. Increase STEM program participation at libraries in communities with populations underserved and under-represented in STEM.**

**Goal 3. Build the capacity of libraries and library staff nationwide** to deliver inspirational and effective STEM learning experiences for their communities.

**Goal 4. Increase the interest and ability of libraries to partner with a variety of STEM professionals and educators** (local, regional, and national) to establish effective,

on-going STEM programs.

With these goals, a set of deliverables were established for Phase 2 based upon the lessons learned from Phase 1:

1. Design and fabricate the Discover Space (DS) exhibit; redesign and expand the Discover Earth (DE) and Discover Tech (DT) exhibits based on Phase 1 results (Fitzhugh et al., 2013); and tour all three nationwide so that most states in the continental U.S. will be able to host at least one Discover exhibit in Phase 1 (18 states) or Phase 2 (24 states).
2. Develop a Small Exhibits Program (Explore Earth, Explore Space, and Explore Engineering) for an additional 40 libraries modeled after NASA’s Visions of the Universe exhibition.
3. Develop new active learning experiences for DS (for host and non-host libraries) in collaboration with professional STEM organizations (e.g., Space Telescope Science Institute).
4. Engage key STEM partners to work with libraries across the country to develop STEM programs (e.g., After school Alliance).
5. Implement a library staff training program (online and in-person versions). Conduct workshops at ALA and other library conferences to highlight best practices in STEM programming. Establish an annual series of webinars (4 per year) on a variety of STEM topics.
6. Greatly expand the scope and reach of STAR Net’s CoP including project team members, librarians, and professionals in relevant STEM disciplines. Critical CoP tools such as the website and monthly newsletter will be revamped.
7. Conduct a comprehensive education research project and disseminate results to the informal STEM education (ISE) and library communities through presentations at meetings (e.g., ALA; the Association of Science-Technology Centers) and publications (e.g., Children and Libraries; Informal Learning Review).

### EXHIBIT DEVELOPMENT PLAN

STAR Net’s Phase 1 and Phase 2 exhibitions followed a multi-phase design and development model (refined since the 1990s) that had been used by SSI’s National Center for Interactive Learning (NCIL) to produce traveling exhibitions for the science museum sector (Dusenbery and McLain, 2009; Dusenbery and Palmquist, 2013). The exhibit design model includes the following elements: 1) Concept



Figure 3: Discover Earth Exhibit Plan. Credit: STAR Net/SSI.



Figure 4: Planet Families touch table in the Discover Space Exhibit and a histogram of user dwell times. Credit: STAR Net/SSI.

Planning, 2) Design Development and Prototyping, 3) Final Design, and 4) Implementation/Fabrication. This museum-based framework was modified to accommodate unique features in the library environment (e.g., the exhibits had to be small, around 1,000 square feet, and the interactives had to be easy to set up and maintain). As with science museum exhibitions, the design of the physical exhibit influenced all other components of the project.

Similar to a strategic plan for an organization, the key elements of the concept plan were to define the Big Idea (Serrell, 1998), establish the scope and nature of exhibit content, develop an underlying organizational approach indicating how selected content could be organized effectively into thematic areas, and delineate an approach to the visitor experience designed to engage and inspire target audiences. The plan provided a blueprint for the integration of all project components. According to Serrell (1998), a Big Idea statement clarifies, limits, and focuses the nature and scope of an exhibition and provides a well-defined goal against which to measure its success. The STAR Net team defined a unique Big Idea statement for each of the three Discover exhibits along with a thematic framework. Each exhibit's concept plan also included a list of potential interactives, a plan for developing active learning resources, and a professional development plan. The Phase 1 planning process for Discover Earth and Discover Tech was described in Dusenbery (2014b).

STAR Net exhibitions centered on three separate themes: Earth Science ("Discover Earth: A Century of Change"), Technology/Engineering ("Discover Tech: Engineers Make a World of Difference"), and Space Science ("Discover Space: A Cosmic Journey"). Extensive title testing was done to select these names. Preferences were for active titles that included people in them in some form (A Century is a human timescale, engineers are people, and journeys are human endeavors).

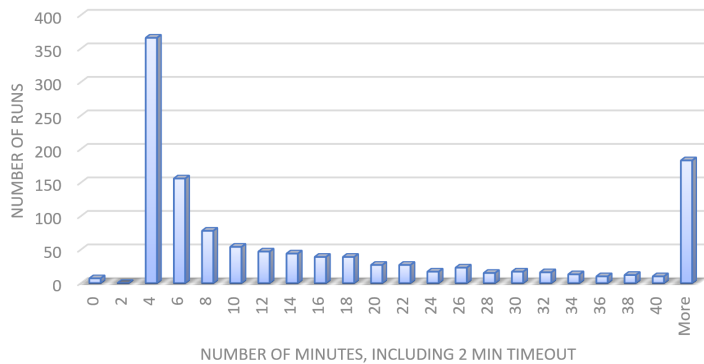
An important component for these library exhibits is

interactivity. Interactive learning experiences include ones that allow user control and exploration (computer kiosks), foster social interactions (quiz games and green-screen experiences), and provide components that relate to the community (Discover Earth Photo Wall, Faces of Engineering, Timeline Wall in Discover Space).

Another way these exhibitions have varied greatly from their museum counterparts is in designing for interaction/dwell times. We learned early on that the same component might have an average dwell time of 6 seconds in a museum could have minutes-long dwell times in libraries (Dusenbery, 2014b). As an example, our Planet Families touch table interactive (see Figure 4), which has been deployed in a number of exhibits, had a median session duration of 8 minutes over 6 months of library use. 15% of those sessions lasted 40 minutes or more, indicating either very committed patrons or constant use by a succession of patrons (or more likely, a combination of both).

There are a few factors contributing to this difference: lack of competition from other exhibits, frequency of library visits, and attitudes towards time spent in the library. Museums often present guests with multiple competing exhibitions, and they're often on different floors or in different wings, so families can't "divide and conquer" as they can do in a smaller footprint exhibit at a library. In a library, families are able to come back to their favorite components multiple times during the library exhibit's run (in Phase 2, it was 3-months for the Discover exhibitions). Families visiting libraries often come in with open expectations, and no set schedule, meaning they can peruse the components at their leisure, especially knowing they can always come back. This is true of both hands-on, physical interactives, as well as digital ones. The knowledge that the exhibit would be visited multiple times gave the development team some license to create deeper digital experiences, sometimes containing multiple experiences in a single kiosk.

Session time for Planet Families  
October-March, 2009



Another key innovation for these exhibits is the addition of “Discovery Tables” that were added to the Phase 2 exhibits. We heard from library staff that they needed more hands-on items for younger patrons, and we also observed libraries having LEGO® areas, sensory tables, and even puzzle tables for older patrons. We incorporated these ideas into our Discovery Table concept, a simple table from Ikea where we added 3 ledges (to prevent things from falling off), and set it up at either low coffee table or high bar table height, depending on where in the library it was located. Each exhibit had two of these tables. The intent was for the short one to go in the children’s area (with items like DUPLO® blocks, sturdy fossils, and planet stuffies), and the tall one to go in the adult or teen area, with more paper-based activities, complicated LEGOs, microscopes and similar objects. The reality is that the libraries put them anywhere and everywhere, switching out items depending on the location (and sometimes on the value of the objects). These flexible components also allowed library staff to add their own items, or even crowd-source for items from patrons for temporary display. Many STAR Net libraries have created their own Discovery Tables after the exhibition has moved on.

### STAR NET’S STEM ACTIVITIES AND TRAINING

*I have been blown away with the follow-up support. The webinars and newsletters are extremely helpful – packed with useful information about programming, ideas, partners and grants. If these had not been offered, I would not have done nearly as much post-exhibit STEM programming. Even though I was fired up about STEM, the webinars, newsletters and STAR Net resources kept me engaged.*

~STAR Net Librarian

*It has been a wonderful experience. I have loved having access to all of the wonderful resources and materials. The exhibit was wonderful, and our patrons really enjoyed it. Being a part of STAR Net has introduced me to more STEM*

*content and concepts and I feel more knowledgeable and confident to lead STEM programming at my library.*

~STAR Net Librarian

Over the last decade, there has been a growing movement toward offering STEM learning programs in public libraries (Shtivelband et al., 2017). STAR Net has evolved over the last decade to support this urgent need.

At its core, STAR Net aims to provide activities and training to help library staff and their partners bring interactive STEM learning experiences to their communities. STAR Net’s online presence — including the website, monthly webinars, the bi-monthly STAR Net News, and its STEM Activity Clearinghouse — disseminates STEM learning resources and provides opportunities for registered members to comment, contribute blogs, rate activities, and more.

The Clearinghouse was funded initially by IMLS and developed in partnership with the Maine State Library and Cornerstones of Science. It is seen as a trusted resource for activities that have been proven to work in libraries and is a direct response to librarians finding inaccurate materials across the web.



Figure 5 (above): The Inventor’s Lab in Discover Tech.

Credit: STAR Net/SSI.

Figure 6 (below): Discovery Table in Explore Tech.

Credit: STAR Net/SSI.



The Clearinghouse is a searchable portfolio of 425+ free STEM activities for use in the library setting. The activities support the role of the librarian as a facilitator of learning, as suggested in STAR Net Phase 1 research (Baek, 2013a). Librarians can search the Clearinghouse based on cost, ages served, content area, level of STEM proficiency required, and other parameters. The Clearinghouse also includes an “Add a Tech Twist” notation, through which the project team makes recommendations on ways that high-



Figure 7: Library staff training session at the ALA conference.  
Credit: STAR Net/SSI.

tech STEM tools (such as a digital microscope or voltmeter) can be integrated into hands-on activities.

Library staff hosting Discover exhibits were specifically supported with activities and training to prepare them to develop community partnerships; set up and dismantle the exhibition; facilitate hands-on programming for a variety of age groups; and participate in project evaluation and reporting. Staff from Discover libraries participated in a two-day, in-person training, where they learned how to manage the exhibit and learn about the hands-on activities. Separate workshops were held for Discover Earth, Discover Tech and Discover Space in September 2015, November 2015, and February 2016, respectively.

Participants were able to meet and talk with the STAR Net project team and network with staff from other libraries that would be hosting the same exhibit. Over the course of the project, library staff were invited to participate in “refresher” webinars, webinars and conference sessions on additional topics, and check-in calls with the project team. For most Discover library staff, STAR Net was the first time they had received training specifically about implementing STEM-based programs.

Active learning experiences were developed in consultation with library staff to support the content areas and themes of the Discover exhibits and serve a broad spectrum of library patrons. The materials were aligned to the ILR January/February 2020 - 14



Figure 8: Discover Earth program.  
Credit: TLL Temple Memorial Library.

Next Generation Science Standards (NGSS Lead States, 2013) to support connections with local schools and infused with facilitator prompts that draw on participants’ prior knowledge and relate to familiar activities or concepts (National Research Council, 2009; Tran and Halversen, 2011).

STEM professionals reviewed the materials for accuracy and four libraries pilot-tested the hands-on activities each with two groups of learners (for a total of at least eight implementations). Family guides were developed based on input from parents, and STAR Net guides include hands-on activities and tips on printable one-page handouts. The final resources form a core collection of vetted programming resources on the STEM Activity Clearinghouse. Guides were also developed to summarize the exhibition content areas and covered standards for libraries to send to schools. These teacher guides, developed in consultation with teachers, were available for exhibit host sites.

### STEM EXHIBITIONS IMPACT COMMUNITIES

*It’s so important to bring these exhibits to rural areas. I know there are a lot of issues with urban areas, but I think it is different when you have some of the same barriers living in a rural area—plus the distance, travel time, etc. It’s just such an incredible opportunity to have something like this in your hometown for us.*

~STAR Net Librarian

As partners to STAR Net Phase 2, the ALA Public Programs Office managed the application, review, selection and reporting processes for libraries that participated in the Discover and Explore exhibit tours. Via Apply.ala.org, ALA published two sets of guidelines and online applications - one for Discover and one for Explore - and managed communications campaigns to recruit submissions. A total of 212 online applications were received, and each one was assigned to two experienced programming librarians who were selected to serve as peer reviewers. Reviewers

were given online access to submitted proposals; assigned numerical scores in response to selection criteria included in the application guidelines, and provided comments for the project team's consideration. After the project team made final award decisions, ALA distributed electronic notification to all applicants, providing grant agreements to selected sites and critical feedback as requested to unsuccessful applicants.

Unlike purely merit based processes, however, peer reviewers and the project team considered a multitude of aspects of each candidate's proposal. While it was very important to know the library had the skills and staffing to host the exhibition, it was even more important that they had identified strategies for reaching underserved audiences, they had identified key partners to support the program, and that they had buy-in of community leaders and stakeholders. In these application processes, we often pick 1 or 2 high profile libraries who have a history of success and can serve as role models for the rest of the group. The remainder were chosen based on a combination of their preparedness for the program, and the need demonstrated for their community. The purpose of Phase 1 and 2 exhibitions wasn't to find the venues that would produce the greatest number of visitors, but rather to find the venues where the community would most benefit, and where there was a chance of lasting change and impact as a result of the program.

Once the grant term began, ALA remained in regular communication with participating libraries, distributing programming stipends, providing customizable media templates, communicating about delivery and pick-up of exhibitions, and collecting interim and final reporting forms through Apply.ala.org. ALA managed contracting with the exhibitions' shipper, Sterling Corporation, serving as the liaison between host libraries and delivery drivers throughout the three-year, multi-exhibition tour.

Host libraries were provided access to a project website that was hosted on iMeetCentral. This site was a "one-stop-shop" for any items exhibit host sites needed in relation to the exhibits, programming, and contact information. The site hosted the exhibit set-up diagrams, tour schedule information, contact information for the project team, media templates for library promotions, images to use for promotion, and many other items required to successfully host the STAR Net exhibits. This site also featured communication tools that allowed team members and host sites to have conversations and ask questions related to the project.

Below are a few quotes from grantee libraries about their experience and the impact the Discover exhibit had on

their community.

*"I was thrilled to be a part of the Discover Tech exhibit. For three months we turned our library into a hands-on science museum - something the children of Juneau don't get to experience in our city. It was completely worth all of the hard work that went into pulling those 90 classroom visits off." -- Juneau Public Library, Juneau, AK*

*"Most of the people who came to the exhibit were astonished that little Plymouth could have something so wonderful right here! And the best part was that getting it here took a real community effort, so many people felt ownership in it. Kids who had seen it before parents couldn't wait to "show them around." Adults who had a part in making it happen couldn't wait to show their kids what they had been working to build. We created some wonderful partnerships as a result of Discover Space. We now know many folks at area schools that we did not before, and have formed a terrific bond with the NH Astronomical Society. Thank you. Thank you. Thank you for this experience. We loved hosting Discover Space." -- Pease Public Library, Plymouth, NH*

#### **KEY EVALUATION RESULTS AND LESSONS LEARNED**

*We are the **perfect venue** to partner with organizations in order to increase STEM learning in our community. **As a trusted education provider that serves diverse audiences, we have the resources and interest to be able to increase STEM learning in our community.***

~STAR Net Librarian

EDC conducted the summative evaluation of both STAR Net Phase 1 and 2, investigating the implementation of the project and its impact on library staff and patrons (Fitzhugh et al., 2013; Fitzhugh et al., 2019). Methods included pre- and post-exhibit surveys administered to library staff, patron surveys, exhibit-related circulation records, and site visits. We highlight key findings from the evaluations below.

#### **STAR Net's professional development and resources helped librarians host the exhibits and deliver high quality informal science education programming.**

Discover and Explore library staff became more confident in their abilities to deliver informal science programs effectively. In Phase 2, the average library staff member increased their confidence from low/medium before STAR Net (as measured by a pre-survey) to medium/high after STAR Net (as measured on a post-survey administered six months after the exhibit left their library). The majority of libraries (85%) organized, hosted, or promoted additional STEM programs in the six months since the exhibit had left their libraries; almost all of the libraries (91%) planned to



offer STEM programs at their libraries in the future. Most libraries (70%) had acquired additional STEM resources because of their involvement in the project.

### The exhibits supported free-choice learning.

It was easy for patrons to interact with the exhibits. Unlike a typical science museum, there was no admission charge to see the exhibits or attend the programming. Adults and children could look at the exhibits whenever they chose—whether it was on a special visit to see the exhibit or related program, or when they stumbled across the exhibit on a visit to the library for some other purpose. Patrons could interact with the exhibits for as little or as long as they liked, and could easily return to interact with different parts of the exhibit again.

The flip side of having such informal, free-choice learning is that some patrons may have been less likely to interact with the exhibits without an additional “push,” such as by having a librarian, a tour guide, a teacher, or a parent encourage them to try it.

### The exhibits supported intergenerational learning.

Several librarians said they observed multiple generations interacting with the exhibits together, and the evaluation team observed several such multi-generational interactions during site visits. Children frequently were the ones to draw their parents in to look at the exhibits. Parents also drew their children in and helped them stay focused on the learning.

### Many library patrons at the host libraries became more interested in, knowledgeable about, and engaged in the



Figure 10: A green screen interactive in Discover Space. Credit: STAR Net/SSI.

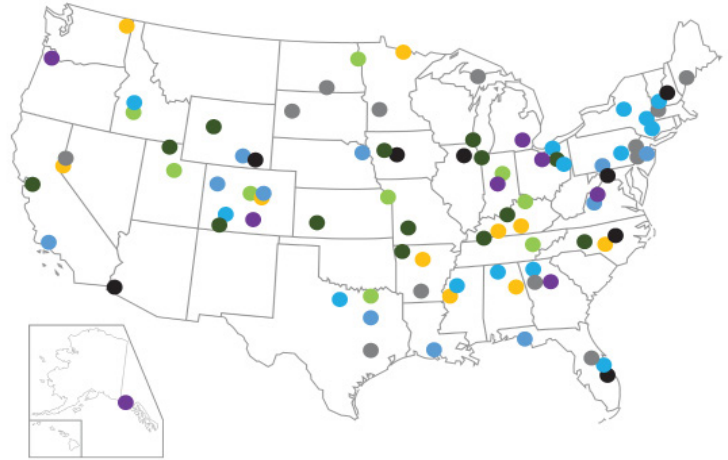


Figure 9: Discover and Explore Host Library Tour Locations for Phase 1 and Phase 2. Credit: STAR Net/SSI.

### STEM topics presented in the exhibits and related programming.

Library patrons found the exhibits and related programming to be highly engaging, and especially valued the hands-on nature of the exhibits. Patrons said that the exhibits increased their knowledge of earth science, engineering, or space. About nine out of ten patrons agreed or strongly agreed they learned something new from the exhibits or the exhibit-related program they had just attended. In interviews, most patrons (65%) were able to recall at least one or two topics and ideas presented in the exhibit about earth science, engineering, or space.

The majority of patrons who responded to the Patron Survey said that the exhibit increased their awareness of earth science, engineering, or space science and increased their interest in learning more about these topics. About two-thirds of the patrons said they intended to use library resources to learn more about science.

Several librarians said that patrons continued to talk or ask about the exhibit, even months after it left their facility. About two-thirds of the librarians (66%) said that patrons had asked for more activities or programs. Many librarians also remarked they believe that patrons now see the library as more than just a repository for books.

### KEY LESSONS LEARNED

When designing STEM learning experiences for the library setting, it is critical to keep the multigenerational nature of this environment in mind. Everyone is welcome in the library, and the learning experience should be designed so that everyone feels welcome to participate.

- The nature of an exhibit tour was a challenge in terms

## Results from the STAR Net Phase 2 Tour:

Phase 2 Tour	Exhibit Visitors	# of STEM programs/ exhibit	Program Attendees
Discover Earth	130,061	95	8,311
Discover Tech	242,281	128	10,901
Discover Science	431,147	166	16,069
<b>TOTAL</b>	<b>803,409</b>	<b>389</b>	<b>35,281</b>

of training and building a CoP because the interventions were not simultaneous but sequential. These types of interventions, however, can be profoundly impactful on the host library, its staff, and community. Strategies for future exhibition programs include multiple, rotating exhibit tours, where libraries stay engaged for 2 to 3 years, and are supported and encouraged to create their own exhibition space while they're not hosting the STAR Net exhibits. Community Dialogues (Holland and Dusenbery, 2019) can also help libraries build meaningful communities of practice, as they share lessons learned from their dialogues with other host sites (<http://www.star-netlibraries.org/resources/community-dialogues/>).

- **Scaling:** There were relatively few differences in librarian or patron outcomes at libraries that received the small Explore exhibits versus the large Discover exhibits (Fitzhugh et al., 2019). Large interactive exhibitions are expensive and are typically hosted by a small number of large libraries. Considering that the number of public library locations is enormous (16,000), small interactive exhibitions show promise for achieving positive impacts in terms of attracting the interest of partners and patrons.
- **Equity:** While 93% of Phase 2 host libraries reported reaching at least one underserved audience, many reported challenges in achieving the full vision described in

their applications. Equity continues to be a high priority in both the library and STEM learning professions.

- **Managing a large CoP:** It's key to decide early on what the CoP's purpose is and how to effectively engage its members. The growth of the STAR Net CoP has been exponential (growing from about 50 members in 2009/2010 to well over 8,000 in 2019). This growth has put strain on STAR Net's ability to serve this large a community. Resources such as the STEM Activity Clearinghouse, our monthly newsletters, and webinar series have helped us serve a growing community of library and STEM professional members.
- **Partnership Building:** Phase 1 and Phase 2 showed how important partnerships are but that they need to be nurtured to have a lasting impact. This is a key factor in librarians taking on the role of curators of community STEM knowledge. STAR Net has been able to assist libraries in building a strong partner network with tools such as the Community Dialogue Framework mentioned above.

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Figure 11: Quiz game interactive in Discover Earth.  
Credit: TLL Temple Memorial Library.

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## ON THE COVER:

*Visitors meet Space Shuttle Atlantis nose to nose at the Kennedy Space Center. Learn more about PGAV and emotion based museum experiences inside.*

*Full story on page 3.*

