

Makerspace Playbook Site Survey: Children's Museum of Houston March 2015



Human Energy®

MAKER ANNEX



CONTACT INFORMATION

Name: Brent Richardson

Title: Invention Convention Educator

Personal social media: Facebook (@brentrichart) and Instagram (@grayhousestudio)

ORGANIZATION

Organization Name: Children's Museum of Houston

How would you describe your organization type (library, museum, school, community organization, etc.)? Museum

Organization website: <http://www.cmhouston.org/>

Organization social media links:

Facebook: @cmhouston

Twitter: @cmhouston

Instagram: @childrensmuseumhouston

Blog and/or site most related to programming, making:

<http://www.kidmakers.org>

Organization news/publicity links:

<http://www.khou.com/story/news/local/2014/07/25/12513264/>

<http://www.click2houston.com/news/new-chevron-maker-annex-at-the-childrens-museum-of-houston/26274844>

<http://www.3dprinterworld.com/article/chevron-teams-with-fab-foundation-10-million-maker-project>

<http://www.wsj.com/articles/childrens-museums-brand-exhibits-with-corporate-sponsorship-1415826288>

Location (city, state): Houston, Texas

Is your organization rural, urban, or suburban? Urban

Is your space and/or elements of your programming mobile? Elaborate, if necessary.

Our makerspace is located inside the Museum and is not mobile. However, elements of programming are periodically brought off-site to an afterschool program the Museum operates at Edison Middle School in Houston's East End.

Target audience(s): Ages 8–14

Annual budget (indicate if public or not public): The Museum's Chevron Maker Annex is currently operating with a FY15 budget of \$87,600, with a majority of expenses funded by grants from Chevron and Museum admission fees.

Percentage free and reduced lunch served (if known): N/A

Access: Is your organization open to public, age restricted (elaborate below), membership-based, free, and/or admission required? Are there specific groups that you serve?

While the Museum's exhibits are targeted to families with children in the range from birth to twelve years of age, entrance to the Chevron Maker Annex is restricted to children ages eight and older, who are accompanied by an adult. Participants include members who pay an annual membership fee, general admission visitors, members of school groups who pay a discounted fee, and visitors granted access at no charge.

Tell us about your organization. What distinguishes you from others?

The Children's Museum of Houston is a nationally ranked museum distinguished by:

1) Free admission practices that are the most extensive of the nation's non-federally funded children's museums. In FY14, 34% of the Museum's 810,000

visitors were admitted free of charge, with unlimited free admissions provided on weekly Free Family Nights and to families who a) make use of the Open Doors passes the Museum distribute to 789 community-based organizations that serve low-income families; b) receive similar passes distributed to the clinics of the Harris Health System (the County's public health provider); and/or c) receive public welfare benefits from the state of Texas. In addition, 100% of outreach programming is provided at no charge to participants, who recorded a cumulative attendance of 344,000 in FY14.

2) A commitment to inclusion through the provision of bilingual (English/Spanish) resources and facilitation that make it possible for people of Hispanic descent to be fully engaged in services. These accommodations are crucial within a region where people of Hispanic descent account for 41% of residents and where 34% of residents five and older speak Spanish in their homes. Within these Spanish-language homes, 47% of adults age twenty-five and older have not graduated from high school, placing their children at a severe disadvantage with respect to the development of the knowledge and skills required in the 21st century workplace. The Museum's response involves the presentation of exhibits and resources in bilingual formats, with half of the Museum's public contact staff and all of its outreach educators fluent in Spanish. These resources, along with the Museum's free admission practices, make it possible for Hispanic families to represent 47% of the Museum visitors and 84% of outreach participants.

3) A commitment to outcomes-based evaluation, with the Museum being the first in the nation to incorporate outcome logic modeling for program design and evaluation. Outcomes of engagement are evaluated annually, with instruments ranging from interviews with parents who use new exhibit components, to third-party evaluations of efforts to increase learning at the Museum and at home through the use of smartphones and tablets (see <http://www.21-tech.org/> for an example). Since 2011, efforts have built on the work of the Board's Evaluation Committee, chaired by Dr. Catherine Horn, Associate Professor of Educational Psychology at the University of Houston. During the course of the past four years, the Evaluation Committee has provided leadership for nine quasi-experimental studies performed with the assistance of Dr. Patrick Leung (Professor/Dean of Social Work at the University of Houston), Dr. Susan Landry (Founder/Director of the Children's Learning Institute at the University of Texas), and the Houston Independent School District.

4) A commitment to efforts to increase knowledge and skills related to the STEM disciplines, which are linked with activities through which children build the language skills required for the study of the STEM disciplines. The Museum has been a leader in the field, producing bilingual exhibits and programs during the course of the past 35 years with the support of major grants from the National Science Foundation, National Institutes of Health, Institute of Museum and Library Services (IMLS), ExxonMobil, and Chevron. The results of this work have been shared with children's museums and science centers across the nation, with the

Museum serving as a leader in efforts to assist science museums to accommodate their youngest visitors. Current collaboratives include the IMLS-funded XCL project, through which the Museum and its partners (New York Hall of Science, Oregon Museum of Science and Industry, Sciencenter, Museum of Life and Science, and The Lawrence Hall of Science) are completing the design of an open-source system that is providing visitors with opportunities to use smartphones and tablets to access digital media content so that they may customize and extend their learning, both at museums and in their homes.

MAKING AND CORE VALUES

What is your mission statement?

The mission of the Children’s Museum of Houston is to transform communities through innovative, child-centered learning.

What does it mean to “make” in your space/ organization?

The Museum’s educators view making as a means of creating open-ended self-motivated learning opportunities in a collaborative environment suited for children. The focus of the making activities is placed on the acquisition of STEM-related knowledge and skills through engagement in project-based learning in which the learner is fully invested in the process.

How does the above relate (or not relate) to your core values?

The core goals of the Museum involve efforts to foster the development of the significant child population of the Greater Houston area by increasing and supporting parents’ engagement in their children’s learning and by providing children with learning experiences that reinforce and supplement school-based instruction. These goals are achieved through service to multicultural, multilingual, and socioeconomically diverse audience, reducing the impact of poverty and promoting the development of skills required in the 21st-century workplace. The Museum’s making activities support goal acquisition by demonstrating how parents can support their children’s involvement in STEM learning, with full access to the Chevron Maker Annex ensuring inclusion while promoting the development of both the technical and soft skills that are preparing children of all socioeconomic classes to enter the workforce.

What forms of making (all creative endeavors) occur?

Within the Chevron Maker Annex, children use traditional hand tools to design and build a variety of objects, learn the fundamentals of computer programming through the use of programs such as Arduino and Processing, build circuits on breadboard platforms, and develop additional skill sets such as sewing and soldering through engagement in a variety of project-based workshops. Involvement can take several forms, with a portion of workshops open for drop-in visitors, and with other reserved for groups that ask to pursue specific content.

Are you influenced by any particular pedagogies (approaches to learning)? In a broad sense, Activity Theory and Vygotsky's Zone of Proximal Development.

What are some good examples of especially powerful/ ambitious/ successful making experiences?

An example of an especially ambitious project involved having a group of middle school students build a 3D printer during the course of five sessions, using plans developed by a 3D printer company. The activity served as a great learning experience, with the students' eyes opened to possibilities related to digital fabrication and with many aspects of electronics demystified. As an added plus, the students were able to donate the 3D printer they built to their school.

GOALS

What are the goals of the programming and experiences provided?

Our goal is to ensure that children have ongoing opportunities to develop and practice the critical and creative thinking skills they need throughout life. Each making experience is designed to provide various points of access and challenge each child, no matter their ability, to develop problem-solving skills as they experiment, test, and redesign. With the support of parents/guardians and museum staff, making provides a framework for kids where failure is not negative but is just one necessary aspect of problem solving.

How do your environment, tools, and materials reflect these goals?

The environment is visually designed to spark your imagination and challenge you based on real-life experiences. Each workshop and activity has numerous examples and images of past visitors creating their own projects. Every table is stocked to the brim with the necessary supplies for each project, allowing visitors to get right to work. We try not to frontload any activity with too much instruction. Each activity/workshop involves enough instructions to ensure a safe working environment, but we try to avoid providing prescribed steps because many times that squashes the creative process and need for problem-solving skills. Our makerspace allows CMH to facilitate experiential, self-directed learning on-site at the Museum. A majority of the workshops feature project-based challenges in which children work in small groups to design, build, test, and refine a variety of mechanical and electronic devices. These activities provide children with opportunities to develop the STEM skills required in the 21st-century workplace, along with the mindsets that foster curiosity, engagement, and persistence.

How do you know when you've met your goals? What are your metrics of success?

Personal testimonies have been the most useful way to ensure we are meeting our goals. When encouraging children to develop their own solutions to problems, it is hard for a facilitator to quickly assess points of success visually. One example of this was during an electronics workshop when the facilitator thought, at first glance, that a visitor did not understand the project, but after talking to the student they realized they were building their own tool to punch a hole in their

paper circuit where a traditional hole puncher could not reach. The child was actually demonstrating a high level of competency with electronics, but since it was demonstrated in an unusual way it took a conversation to understand. We also measure time spent on each featured workshop activity: namely, if visitors return to the makerspace for a second or third workshop and if they complete their project.

What are your plans and hopes for the future of your space and programming?

Currently, our makerspace is offering workshops for group reservations and workshops for drop-in visitors. Just over one quarter of drop-in visitors attend multiple workshops and are constantly asking for new workshops. Our goal for the future is to grow this group of return visitors and develop a four-part curriculum allowing them to earn certifications in different skillsets in order to allow them to bring their own projects to the makerspace during “Open Studio” time. The four-part series will include one section over basic hand tools/woodworking, electronics, 3D modeling/printing, and laser cutting.

TOOLS

What are your most frequently used and commonly available tools? (Anything used to make with, no matter how simple. Scissors count!)

The tools that are most commonly used in the Chevron Maker Annex include hot glue guns, gloves, scissors, alligator clips, breadboards, Arduinos and computers, with 3D printers and laser cutters used for project prototyping.

List any special tools that require supervision, training, and/or certification.

Children receive instruction in the use of all tools provided within the Chevron Maker Annex, with detailed instruction involving the safe and purposeful use of soldering irons, the 3D printer, laser cutter, saws, hammers, drills, staple guns, multimeters, and box cutters.

What are the favorite tools (most popular/most desired, even if you don't have many, or just one)?

The 3D printers are by far the most popular tools, followed by the laser cutter, with children almost instantly recognizing the potential they hold.

Are there any tools that go largely unused, or that are no longer provided? Reasons?

The soldering irons within the Chevron Maker Annex are at this time underutilized, given the need to keep costs low through the use of breadboards and paper circuits. Note, however, that instruction is provided regarding soldering processes but with staff making the most frequent use of the irons to assemble electronic devices.

MATERIALS

What are some of the most popular, and frequently used materials?

The materials most frequently used within the Chevron Maker Annex include masking tape, hot glue, craft sticks, pipe cleaners, cardboard, plexiglass, 3D printer filament, giant paper rolls, and foam beads.

What are some of your most interesting/ unexpected materials?

Anything that can conduct electricity can have surprising applications. Pipe cleaners, for instance, can be used in circuits and produce interesting results. Additional conductive materials include washers, nails, foil, and graphite.

What are the most continually reused materials? Most consumed?

Most of the materials in the Chevron Maker Annex are consumed versus reused, since children are encouraged to take their projects home with them. The most consumed materials include cardboard, cardstock, paper, hot glue, craft sticks, and markers.

Share any specific or general sources for materials.

Suppliers of materials include Sam's Club, S&S Worldwide, DigiKey, Electronic Goldmine, eBay, Goodwill, SparkFun and RadioShack.

COLLABORATION

What are some of the institutions and organizations that are sources of inspiration, support, and influence?

Both Chevron and The David and Jean Wiley Foundation have been instrumental to the success of the Museum's maker activities through their funding and the provision of encouragement and technical support. Additional partners include The Exploratorium, Lawrence Hall of Science, Maker Ed, Children's Museum of Pittsburg, Boston Science Museum, New York Hall of Science, ASTC Maker and Tinkering CoP, and Maker Faire.

Describe any local, national, and global partnerships and collaborations.

Exploratorium as mentor, Maker Education Initiative as staffing infrastructure collaborator, Houston TXRX Labs/Rice University Oshman Engineering Design Kitchen as local advisors, and the Museum's own Community Science Workshop at Edison Middle School.

SPACES AND ENVIRONMENT

In what physical places does making happen in your organization? A single dedicated space, multiple dedicated spaces, general use areas, a workshop (metal, wood, sewing, etc), outdoors, a theater, a music studio, an art studio? Everywhere? Somewhere else?

Within the Museum, making takes place within The David and Jean Wiley Foundation Invention Convention exhibit, and in the adjacent Chevron Maker Annex. These two spaces have different but highly related goals, with the Invention Convention exhibit and associated Inventors' Workshop providing both self-led and facilitated project-based activities that engage children in a wide variety of entry-

level making activities. The Chevron Maker Annex provides a higher-level makerspace where children may pursue projects of their own design after completing a four-part series of safety and skills training.

Through outreach to Edison Middle School, the Museum has operated a Community Science Workshop makerspace for the past 14 years. It was originated through NSF funding and one of the first out-of-California national Community Science Workshop sites.

Elaborate on where making happens, if needed.

The making opportunities featured within The David and Jean Wiley Invention Convention exhibit engage visitors in efforts to build, test, redesign, and retest devices that include stomp rockets, LEGO test track cars, paper airplanes, sail cars, marble runs, and parachutes. Projects are designed to be intuitive and self-guided. This activity is supplemented by opportunities to create a designated project in the Invention Convention's Inventors' Workshop, with facilitation providing during all hours of operation and with a new project offered weekly. Projects built and tested in the Inventors' Workshop include catapults, rubber band planes, paper circuits, bridges. The Chevron Maker Annex is adjacent to the Invention Convention exhibit and serves children ages eight and older who are accompanied by an adult.

How are the spaces, tools, and materials organized?

We keep an abundance of materials within hands reach in our different spaces. Many tables have troughs to hold material in the center of the table. Throughout each space visitors can also find materials are in bins like you might see at a hardware store. Our makerspace has open storage for materials and tools on the wall using a French cleat system.

All tools and materials in the Chevron Maker Annex are labeled by colors to indicate who is allowed access. Green tools/supplies are free to use on projects (tape, pencils, hole punchers, paper, foam, cardboard, etc.). Yellow tools/supplies need adult supervision or specific instruction before use (pliers, screwdrivers, duct tape, clamps, etc.). Some supplies and tools marked yellow are more expensive and we like to ensure are not being wasted. Red tools/supplies involve a training before use (hot glue gun, soldering iron, electric scissors, saw, motors, batteries, power adapters, etc.).

How large is the space(s) where making happens?

The David and Jean Wiley Invention Convention exhibit occupies 3,100 sq. ft. of exhibit space, with the Chevron Maker Annex occupying an additional 425 sq. ft.

Please describe how your site and makerspace(s) are staffed, including numbers of full and part-time staff and volunteers.

The David and Jean Wiley Invention Convention is staffed during all hours of operation by a series of Discovery Guides (paraprofessional educators) who facilitate the activities in the Inventors' Workshop. The Chevron Maker Annex is

staffed during the school year by two part-time employees who are members of the Maker Corps—with the Chevron Maker Annex open to visitors ten hours per week. Additional staff are hired for the summer months, when the Chevron Maker Annex is open twenty hours a week. Volunteers provide additional coverage and facilitate many of the workshops provided within the Chevron Maker Annex. The staff in the Chevron Maker Annex are attending college for an engineering related discipline and highly qualified to facilitate maker activities.

First impressions of space(s):

Ideally, when participants first enter _____, they see _____. They hear _____. They feel _____. They experience _____. They leave with_____.

Invention Convention gets visitors excited to create. The first thing people see when they enter the exhibit is a huge kinetic sign with moving gears, fans, and lights. Once inside the space guests are put on a show for each other as they test their inventions for everyone to see. You might see a child jump on a tire to shoot a stomp rocket or climb a flight of stair before releasing their LEGO creation speed down a track as they race their friend. The creative energy inside Invention Convention is contagious and there is always something inspiring to see. Since each activity is designed to accommodate multiple visitors, if an activity stands out as another visitors completes it, there is room to join in and create your own.

Each family who enters the Chevron Maker Annex is greeted by a staff member, told what that day's workshop will involve, and informed of the requirement that all participating children be age eight or older. Families who are interested in participating in the workshop are then asked to complete a waiver, after which they are provided with a guide that presents pointers and outlines various processes that are useful to each workshop. These guides help visitors frame their questions, building confidence in both parents and their children and decreasing the stress on the staff members.

Describe your approaches and priorities in creating environments for making/learning.

A primary tenant of the Museum emphasizes the need to equip parents to serve as their children's most influential teachers. Therefore, the projects in which children are engaged do not separate them from their parents (or other adult caregivers) and provide parents with opportunities to coach and encourage regardless of their own levels of educational achievement. This approach helps to create a safe and supportive learning environment, and also allows Museum staff to serve the maximum number of families. In the Museum's makerspaces, parents are either working on their own project next to their child(ren) or working on the project with their child(ren). For this reason, staff ensure that more than enough supplies and tools are on hand for every project so that visitors are never constrained due to lack of preparation.

PROGRAMMING

How did your space and programming get started?

The David and Jean Wiley Invention Convention was opened in 2009, with the making that happens there having laid the groundwork for the development of the partnerships that allowed the Museum to open a higher-level makerspace with the support of Chevron. In our first year with the Maker Corps program, the Corps Members connected the Museum strategically with the local TXRX Labs makerspace. Through the successes, influence, and advocacy of the initial Corps, we were able to secure funding from Chevron to open the new Maker Annex.

How do you decide on/design/make possible the space and components of the program?

The components in Invention Convention are designed as modules typically involving one space to build/redesign and one space to test. These component should be intuitive and either make use of non-consumable supplies or supplies that can be sourced in mass quantities inexpensively. We strive to design components that can accommodate 4–6 people at one time and teach STEM concepts.

The programming provided in the Chevron Maker Annex is prototyped by the Museum’s Maker Corps members throughout the year and reflects the range of their interests and expertise. Potential projects that reflect criteria for open-endedness, budget constraints, and alignment with STEM concepts are prototyped and tested with visitors. Additional activities are designed for school groups that request projects that address specific concepts not covered in existing maker options.

How has your environment and programming evolved? What has worked well, and why? What has changed? What could still be improved?

Invention Convention started off as a space where the making focused more on science, engineering, and math than technology. Over time we have incorporated technology into the components and are now starting to focus on ways to teach computer programming and robotics. In this space components that are collective experiences and have obvious payoffs, like stomp rockets, are the most popular. There are many activities competing for visitor’s attention, and children tend to struggle to complete an activity by themselves when their friends are having fun across the room doing something together.

When the Chevron Maker Annex opened in June 2014, initial concepts called for workshops to have a designated start time and finish time, usually spanning an hour in length. It was quickly realized that this format would be problematic, with a portion of visitors missing the start time, finishing early, or signing up and not entering as scheduled. After experimenting with different formats, adjustments were made to allow visitors to drop in during certain timeframes and work on the projects until they are finished. This format requires greater staffing, since one person cannot provide instruction and support when visitors’ entry points are variable. A team of volunteers has made this approach viable, supplementing and extending the capacity of staff.

EQUITY AND ACCESSIBILITY

Are there segments of the population that you hope to serve better?

Efforts are currently underway to better serve visitors who speak languages other than English or Spanish without any compromise to safety. This work will include the development of videos and graphics that describe processes through imagery, with the use of certain tools restricted until such a time that safety concerns can be adequately addressed.

What strategies do you employ to help increase the accessibility of your space/program to all learners?

We develop projects to have several variations for kids of different ages and abilities. Facilitators are trained on each activity and are taught different way to adapt projects. We strive to use age-appropriate vocabulary with visitors to ensure that our dialogue is productive. When communicating with children, facilitators are encouraged to ask questions to determine any points of success a child has. For some kids, learning to tear tape is an achievement and it should be celebrated not ignored. High-achieving children might need additional challenges to peak their interest. To increase accessibility, it is important to get to know every learner and practice improvisation to cater instruction to each individual.