

SAN JOSE PUBLIC LIBRARY'S

MOBILE MAKERSPACE GUIDE

sjpl.org



San José Public Library

Mobile MakerSpace Guide

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INTRODUCTION

To make something is to be empowered. Making increases confidence and competence in areas beyond Science, Technology, Engineering, Arts, and Math (STEAM). It doesn't just teach people how to use tools; it teaches them how to solve problems creatively. Through making, people learn how to fail successfully and to approach any of life's challenges with imagination and determination.

The library has long been a place of experimentation and skill building. In the last several years, libraries have begun to offer more hands-on learning and technology exposure opportunities to their patrons. They've built spaces where people from all walks of life can learn how to utilize a new piece of tech or make a project they've only ever dreamed about.

As technology started to become more prevalent in people's lives, libraries were the first adopters; they became places where someone could come to learn and use equipment that was often prohibitively expensive. Patrons accessed the Internet for the first time, learned to type, used printers, and more. As technology has become more ingrained in everyday life, the divide between the haves and have-nots has widened. Libraries are the great equalizer, providing technology and training to anyone in the community who is interested. They've been able to gather resources to create centers of empowerment through making, technology training, and other hands-on learning programs.

A movement is taking place around the world today. The Maker Movement, as some would call it, is categorized by a resurgence of people doing it themselves. A hundred years ago the term maker didn't exist, it was simply called living. If something broke there wasn't a quick and cheap replacement waiting to be purchased at the click of a button online, delivered to your doorstep in less than 24 hours. However, in recent years, there has been a surge of people making for the sake of making. They don't make because it is easier; they make because the act of creating is empowering. The creation now holds meaning and a story.

Makers have tired of having big corporations telling them what they should want or need. They see the world as a malleable space that can be shaped to fit their imagination. We've entered an era where tutorials on how to create something are a click away on YouTube. Thousands of people gather on social networks to share projects and give tips. Tools that were once only available commercially, such as laser cutters and 3D printers, are small and affordable enough to sit in living rooms. Makers are using these resources to explore new tools and technology, often blending them into more traditional mediums, such as woodworking and sewing.

Libraries have discovered they are the perfect institution to provide a place for people to learn and make. While tools have come down in cost, they are still too expensive for the average consumer to invest in without any previous experience. Where once the library purchased

PCs and Internet access, they are now investing in 3D printers and desktop CNC machines. Libraries are centers of innovation. They are providing a safe place to nurture makers of all ages.

Many of modern civilization's most profound developments were initiated here in San José and Silicon Valley. These developments were the result of someone with an idea and the ability to bring it to life. More than ever, people here are harnessing that legacy, breaking out of the role of consumer and becoming creators, innovators, and entrepreneurs. The concept of Library is expanding from a place for consumption of information and media to a place for self-directed and peer-assisted learning, creation, invention, and entrepreneurship. Hands-on technology learning can expose disenfranchised youth and adult residents to opportunities to develop skills, accessing the hardware and software industries that are booming around them in the Silicon Valley.

Thus, the San José Public Library (SJPL) created STEAMstacks maker programs. While STEAMstacks encourages local community engagement, it is also part of a new international movement fostering creative, social thinking and lifelong learning through making. SJPL intends to be a key node in that connected learning network, incorporating its capabilities into the community's overall knowledge infrastructure.

With the STEAMstacks programming model in line, we at SJPL began looking at how we might expand upon the current model to offer services directly to the people who need it the most. For years libraries have used the bookmobile model to offer services to patrons, ensuring that community members across a service area gained access to materials. Using this same model SJPL began dreaming up a mobile makerspace—a lab filled with technology and work spaces which would allow people to become creators, innovators, and entrepreneurs. A vehicle allows the library to create partnerships with schools, community partners, and other establishments without requiring their target demographic to seek out the library, taking location and transportation out of the equation.

This guide book will give you best practices and tips for creating your own mobile makerspace. It could be a vehicle built from the ground up, as we have done in San José, a box truck renovation, or even boxes filled with supplies that are brought out into the community for programming. Regardless of the form factor, you will learn how to engage your community with STEAM learning activities outside of the library walls.

WHO IS THIS GUIDE FOR?

This guide is for libraries and librarians that are looking to expand their maker and/or STEAM programming. Having a basic understanding of Design Thinking or the willingness to learn is critical to the success of the project. There are several guides which can help you learn more about Design Thinking, including IDEO's (ideo.com) Design Thinking for Libraries (designthinkingforlibraries.com) and the Design Thinking Quick Start Guide (stanford.io/1Slwu2i).

GATHER YOUR TOOLS

STAFF TEAM

Building a solid staff team is an important first step in building your mobile makerspace. The staff team will drive the success of the project and provide key insights in the community. Invite staff who have experience working with your target demographic. Individual team members should have support from their supervisor to spend time on the project. Members should be open to trying new things and be quick learners. Successful teams will understand that failure is always an option. They won't be easily frustrated, can learn from mistakes, and iterate.

While it's important to include at least one member from your management staff on the team to make final decisions, frontline staff are vital in developing and running program prototypes. Have defined roles and responsibilities for each member of the team. Assigning a dedicated project manager helps ensure the team is meeting its goals and deadlines and understands how to succeed in their role.

TEEN TEAM

Bringing on board a teen team to work in conjunction with the staff team gives key insight into a target demographic. A teen team can drive future community engagement by building a group of stakeholders that will promote the service to their peers. One member of the staff team should be assigned to lead the teen team and act as a liaison between the two groups.

Ideally, recruit teens who are technologically savvy (or interested in learning), highly motivated, and representative of your entire service area. Stay mindful about being inclusive of socio-economic diversity. On an application, look for notable skills and/or accomplishments, leadership skills, familiarity with makerspace technology, hobbies, interests, and time commitment. Interviewing teens who have stellar applications gives them a chance to practice a real world skill and your staff liaison an opportunity to decide which teens are the best fit for the team. Teen team meetings happen in parallel to the staff meetings with a briefing by the staff liaison to both groups.

SUGGESTED TEEN MEETING OUTLINE:

Meeting One

- ▶ Teach Design Thinking techniques
- ▶ Introduction to vehicle

Meeting Two

- ▶ Interview techniques
- ▶ Empathy-building exercises
- ▶ Identify stakeholders
- ▶ Design interview questions
- ▶ Send teens into community to interview peers and use an online form to collect data

Meeting Three

- ▶ Share interview data
- ▶ Identify key trends
- ▶ Create a list of design recommendations describing what the space should have and do
- ▶ Brainstorm a list of technology to fit the design

Meeting Four

- ▶ Review other mobile labs and makerspaces
- ▶ Create prototype of vehicle

Meeting Five

- ▶ Discuss program opportunities
- ▶ Prototype programs and develop plan for implementation

Meeting Six (with staff team)

- ▶ Discuss real-world program prototypes
- ▶ Prototype vehicle using new knowledge

FUNDING

Securing funding is an integral part of the design process. Understanding the scope of the project from the beginning will allow you to design within your budget. Consider internal and external funding opportunities. Local community partners or businesses may be interested in donating equipment or money. Sponsorship opportunities may also exist, such as giving companies space for their logo on the vehicle in exchange for monetary support. Seek out grant opportunities to supplement or fund the project.

ORGANIZATIONAL SUPPORT

Support within your library is key to a successful mobile makerspace. Libraries who have a commitment to STEAM learning activities will be positioned to provide committed staff and resources to a vehicle. It is helpful if STEAM and maker activities are already being run at branches. This allows for your team to develop programming for the vehicle and then detail the modifications needed to bring it to the branch or vice versa. Patrons who are not reached by the vehicle will have the opportunity to attend similar programs at their local library.

An internal culture that supports innovation is also critical. The human-centered Design Thinking process involves being comfortable with prototyping and failing quickly, so that its adherents are able to learn from mistakes and iterate. This methodology is contrary to how many organizations are structured to develop services. Embracing small risks for large rewards allows for innovation to flourish within an organization. You might find allies in former bookmobile drivers and librarians who like technology programming, but a mobile makerspace is outside the realm of traditional library services. Due to the nature of the new service, organizational buy-in for innovation will help you move the project forward with fewer roadblocks.

OUTSIDE SUPPORT

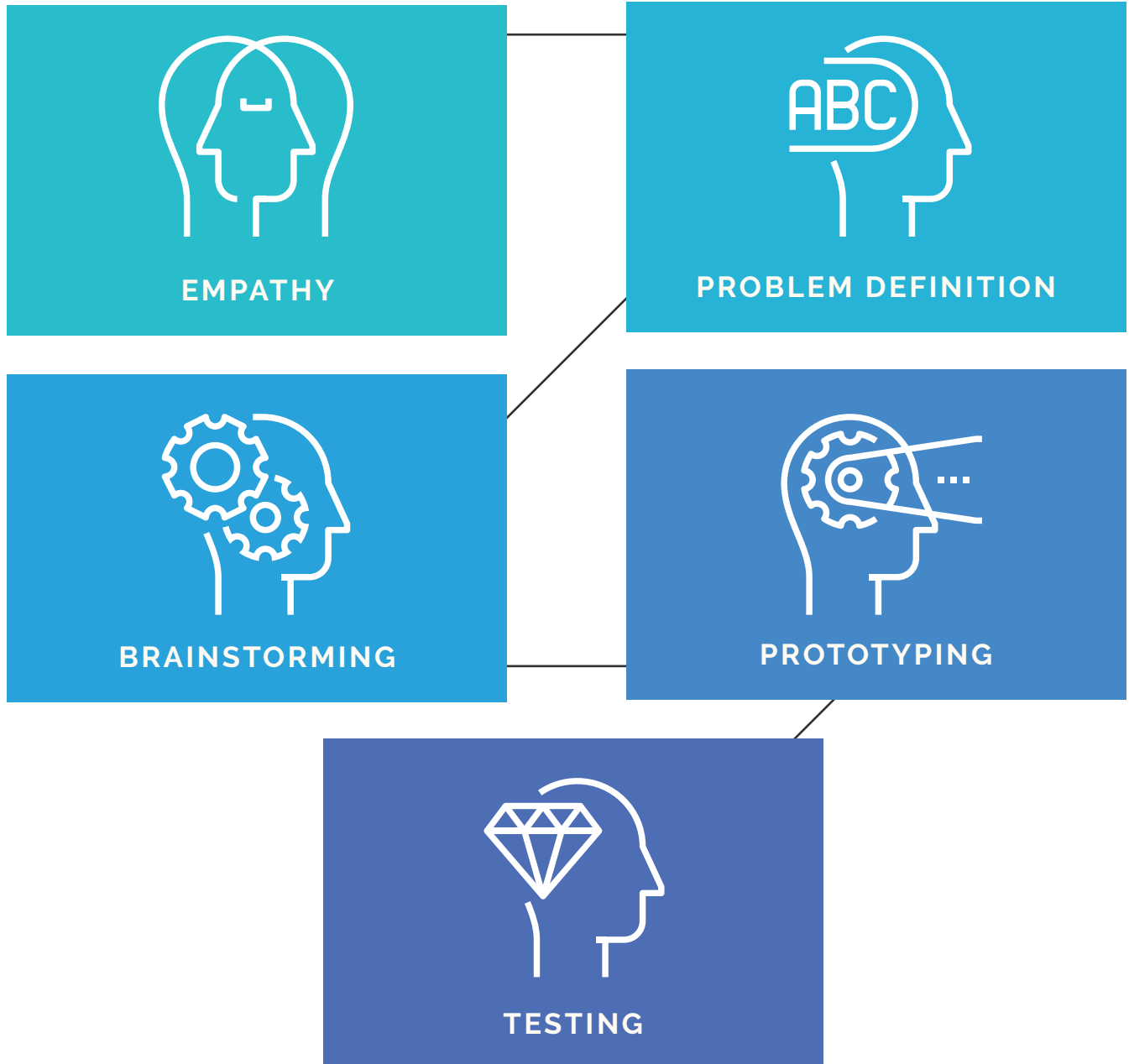
In addition to organizational support, you will need support from other agencies. Your biggest ally will be your local jurisdiction's fleet management staff. Enlist the support of the fleet staff early in the process. They will have connections to fabricators who can help take your prototype from napkin sketches to blueprints. Fleet staff can assist in writing the Request For Purchase (RFP) and assessing feasibility, specifying a timeline, and determining cost.

Connect with local schools/teachers, museums, and makerspaces for assistance in program development. A teacher may be interested in working with librarians to develop a semester-long program for students at their school, while a museum may want to develop standalone programs that align with current exhibits. Bringing partners on board for program development can expand offerings to the patrons, enhancing library offerings.

Other great resources are existing mobile labs and makerspaces! Connect with mobile makerspaces and labs across the country through the Mobile Lab Coalition (mobilelabcoalition.com/wp). Those who already have vehicles up and running can give you guidance and feedback during your design phase. Once operational you will have established a network of partners who can provide support. Local makerspace staff can provide guidance on recommended tools and technology, provide staff training, and help in developing policies for equipment use on board.

LESSON LEARNED

THE DESIGN THINKING PROCESS



A good mobile makerspace design is more than simply shoving tools into a trailer and hoping that they will be used. By using Design Thinking, libraries can explore true user needs and then design accordingly. Design Thinking is a repeatable process for crafting solutions to complex, evolving, open-ended problems that don't have a single right answer. Popularized by IDEO and the Stanford School of Design (d.school), Design Thinking is now used in many disciplines to create human-centered solutions.

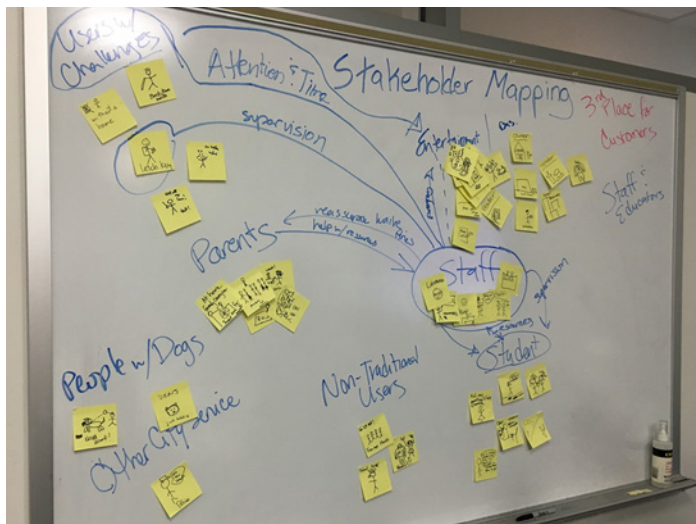


Concept

The first step in the Design Thinking process is empathy. This step involves going and talking to people in the community. Through interviews, teams can gain an understanding of community needs.

Best Practices

Use this first stage as a chance to teach teams the Design Thinking process. Go over each of the different steps (listed on previous page), creating a timeline for the project. At the first meeting, you can learn by doing through setting up a rapid Design Thinking prototype session. Decide on an area of focus outside of the vehicle design. Develop a how-might-we question, brainstorm interview questions, and invite a group of patrons who fit the target demographic for the focus area. Have team members practice interview techniques with this sample group. Incentivizing patrons with small gift cards works well when recruiting volunteers for interviews; consider asking Friends groups to donate the funds for these. After the sample interviews, the team can quickly brainstorm and prototype solutions. This rapid demo process introduces the team to Design Thinking, giving a better understanding of what is to come in the months ahead.



- Stakeholder map from project identifying stakeholders for question, "How might we create a library which acts as a third place for customers?"

Turn the focus to the mobile makerspace. Begin by creating a stakeholder map. With sticky note notes in hand, allow each team member to draw potential stakeholders for the space. Encourage everyone to draw! The brain processes pictorial information differently than text. When you see a wall of pictures it's easier to separate unique ideas rather than looking at all text. People will often hesitate when asked to draw. Remember that drawings do not have to be masterpieces, and ideas can easily be shared through stick figures.

Think about who is impacted, what they care about, and how much influence they have on the project. By stepping back and looking at a diverse range of stakeholders, new opportunities may present themselves. As a stakeholder is drawn, place it on the whiteboard. Give a set amount of time for brainstorming—no more than five minutes. When all the stakeholders have been placed on the board, review them together and move the sticky notes into groups when similar stakeholders appear. Identify the key groups from this mapping project. These will be the groups to interview in the community.

In small groups the team can begin to brainstorm interview questions. Think about questions you want to ask of all groups versus which questions are specific to only one demographic. Make questions open-ended, or use the starter phrase, "Tell me a story about...". Once a list of questions has been developed, create an interview template for staff to use when speaking with stakeholders. Encourage staff to bring a recording device with them to interviews. This allows staff to focus attention on the conversation rather than taking notes. If a recording device is not available, send two staff out with one person acting as a note taker. Later, review the notes and draw pictures of key points gathered from interviews on sticky notes. Using a different color sticky note for each of the stakeholder groups will make it easier to visually identify the groups in future meetings.

Case Study

Our community interviews yielded many insights. We found that students loved having access to technology in the classroom but wanted more access to things like 3D printers and laser cutters. Librarians, on the other hand, enjoyed and desired more practical technology such as automated materials handling machines and improved Internet bandwidth. When we asked people to tell a story about something they made, adult literacy learners often described baking cakes, knitting scarves, or growing vegetables. Teens built everything from Iron Man costumes to Android apps. Everyone was in agreement that they wanted to make something with a practical solution. They wanted a challenge or problem to solve: real-world skills.

See interview questions in the appendix.



PROBLEM DEFINITION

Concept

In this step, you're trying to identify the problem you want to solve. Look at the information gathered in the empathy stage and ask, "What need exists in the community that the vehicle will solve or address?"

Best Practices

This is where you're going to get into creating a question that will drive the entire design process. Design Thinking uses the starter phrase, "how might we..." to define problems. Defining the problem appropriately is critical because the definition shapes the possible solution set. For example, if a problem is defined as "How might I buy a new car?" then there is only one solution: buying a new car. While it raises other questions such as make, model, financing, mission, etc., it closes other creative solutions such as a scooter, bicycle, and ride sharing. If the problem is defined as, "How might I get from school to home to work?" then the set of solutions becomes wider.

Gather all the sticky note drawings from the interviews and bring them to the next meeting. Write questions on the board or large sticky notes which can be placed on the wall. Place the sticky notes on the board, reviewing them with the team as they are placed. Pull out large themes as they become apparent. Identifying these themes will help you to define the problem. You are not looking for solutions; you're looking at needs.

Once themes have been identified, you can start brainstorming the "how might we..." question. Select one team member to act as a scribe and have the team call out ideas to write on the board. You'll notice that ideas build upon each other and become more refined as they go along. Once again, set a time limit for your brainstorming session. At the end of the time limit you will have several "how might we..." questions written. Synthesize together, taking the ideas from each statement and coalescing them into one "how might we..." question.

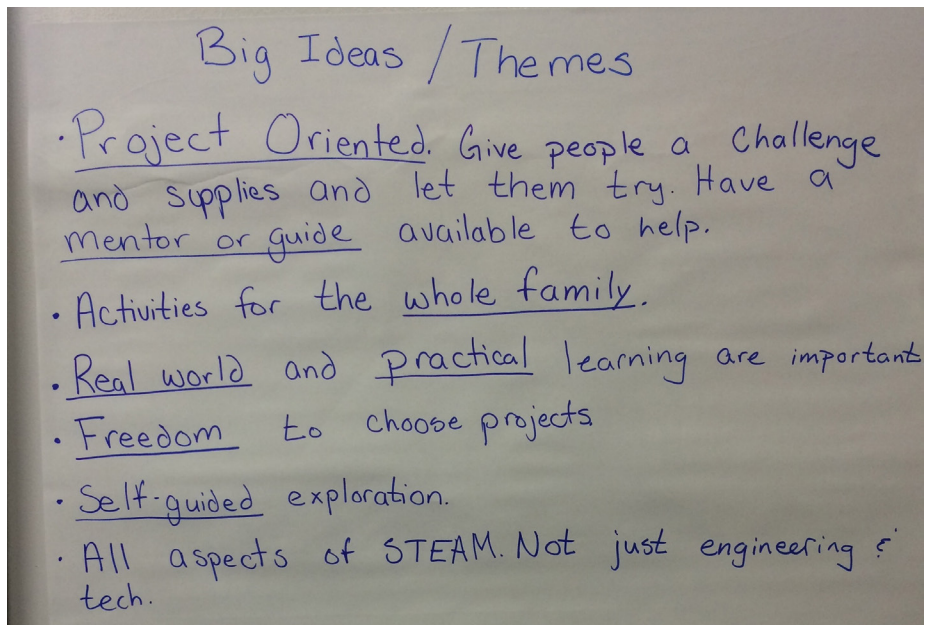
Case Study

Upon reviewing interview data, several big themes stood out. All of the stakeholder groups we interviewed were interested in projects. There was a clear interest in learning by doing and the application of skills rather than simply learning from a book, course, or anything without a relevant project. This style of learning is often referred to as Project-Based Learning.

People were interested in open-ended design challenges that could inspire them to create a novel solution. Teens and adults wanted to have a guide or mentor available to help, but not necessarily to provide direct instruction. They seemed to want the just-in-time learning that comes when you hit an obstacle and need to ask for help. Middle school students tended to want more instruction and guidance in projects. Teens wanted the freedom to choose their own projects and engage in self-guided exploration rather than following a syllabus. They spoke about having to follow a set plan in all other aspects of their lives. The MakerSpaceShip sounded like a place where they could be free to explore. Building upon that, there was a desire for projects with an immediate practical application. Adults especially were not as interested in abstract skill-building.

People who were surveyed wanted activities for the whole family—not just for kids or seniors. They were also interested in all aspects of STEAM—not just in engineering and technology. Our interview teams fielded requests for science projects and the arts. People expressed a desire to see how disciplines intersect to create a language that they could use to shape the world around them.

Looking at these themes, the team developed the question, "How might we inspire people to solve problems creatively?" We determined that this problem definition would allow us to create experiences that provide tools to solve problems creatively, as well as inspiration to solve them. This is different from "How might we teach the public new technologies?" or "How might we extend the library's mission in a mobile vehicle?". Both of the latter problem statements might involve programming, but the focus isn't on inspiration and creative problem solving.





PROTOTYPING

Concept

Create low fidelity representations of the solutions to the "how might we..." question.

Best Practices

Start a "Design Thinking box" to use during prototyping sessions. Include supplies such as construction paper, pipe cleaners, clay, sharpies, sticky notes, and other assorted odds and ends. Having a box makes it easy to start prototyping right away. Anything can be prototyped using these basic supplies.



Prototyping gives the team a chance to explore solutions more deeply. Put the sticky notes with solutions from the previous meeting back on the board to allow for quick reference.

It is important to conduct several prototyping sessions. In the first, remove all barriers in order to elicit creative ideas. Free the team from cost restraints and/or add in magical elements. By opening the realm of possibilities, you can see a bigger picture and hone in on key themes. The first prototype is not meant to turn into a real world program.

Break into smaller groups and choose a stakeholder group as the prototype's target demographic. These prototypes should be for programs featured on the vehicle. Then, choose a theme for both groups to work from, such as space, chemistry, or video production. See how different the program ideas are using the same theme and solving the same problem!

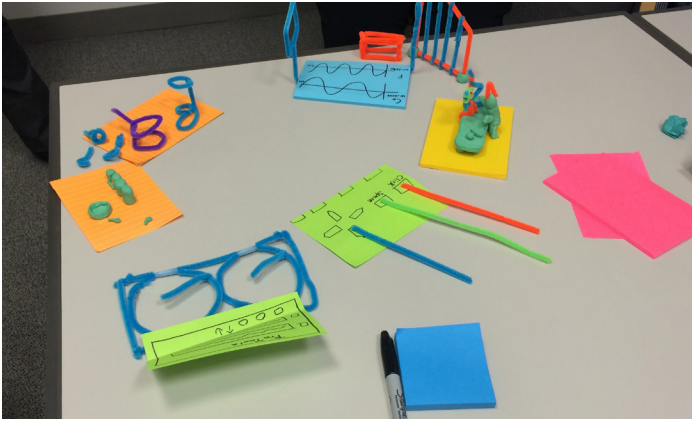


Give each team twenty minutes to create their first program prototype, then gather teams together afterwards to share their ideas. Some teams may choose to act out their prototypes, while others may stick to a more traditional presentation. Discuss the prototypes, providing feedback to each team. Separate back into smaller teams and iterate, redesigning the program based on given feedback. Presentations are given again after the iteration process. In subsequent meetings, prototype programs that you plan to use for real world testing.



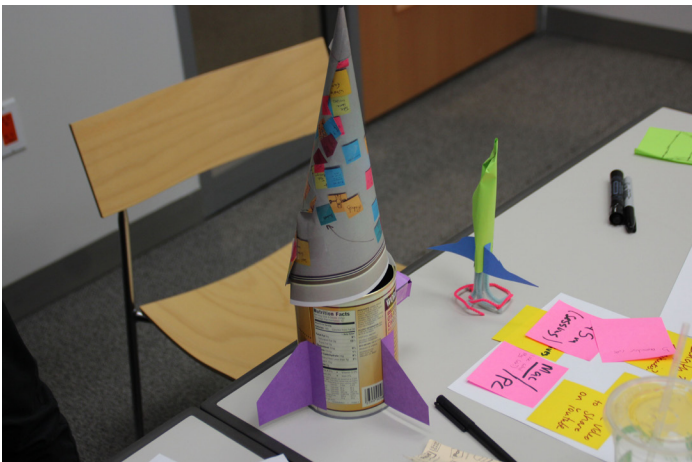
Case Study

To explore some of the ideas more deeply, we broke into two teams. Each team made a prototype of an experience in the vehicle. This was not just a prototype of a class, but a prototype of the entire experience. In the first free and open prototype session, we didn't choose a theme and instead focused on teens as the stakeholders.



For the space theme, the team assigned to middle school students designed a rocket building and launching program. The team targeting high schoolers created a Mars survival challenge teaching students how to design and build 3D objects. For video production, the middle school team planned a five day video training course, introducing students to storyboarding, filming, editing, and sharing. The high school team designed a more hands-off program with different video stations, allowing teens to jump in wherever they felt most comfortable. We used lessons learned in our community surveys to influence the design process during this stage. It was discovered through community interviews that the middle school students needed a more directed learning experience; whereas, the teens wanted to have experts available when needed but have the freedom to explore and learn on their own.

The first group created a musical experience with various stations for participants covering a wide range of different technologies and skills. Participants could go to one or all of the stations depending on their interest levels. Stations included: DJing, found object instruments, make your own instrument (woodshop), and soundwave investigation using an oscilloscope.



The second group created a "magical experience." They wanted the experience in the Maker[Space]Ship to instill a clear sense of fun and limitless possibilities for the patron. To convey a sense of magic, smoke would billow out from the back door as patrons approached, and an alien creature would greet visitors from a giant screen inside. The alien would explain that its ship had crashed and it needed the patron's help to fix the spaceship and return to its planet. Patrons would be guided through a workshop by the alien, learning different skills along the way to help achieve the end goal. While this idea is beyond the library's ability to execute, it is a good example of how brainstorming can generate powerful ideas, and the exercise helped to convey the sense of magic we wanted to bring to the ship.

For the next round of prototypes, we decided to use two themes: video production and space. Each team was assigned to a different stakeholder group, with one team prototyping for middle school students and the other for high school students. Teams were constrained to real world possibilities, and the lessons learned would be used in creating programs to test in the field.



Concept

Learn by doing: bring prototypes out of the library and into the community.

Best Practices

The biggest takeaway at this stage of the process is embracing failure! This is a chance to learn and not everything will work the way you think it will. Adapt on the spot, taking note of what worked and what didn't. When you select prototypes for testing in the community, keep in mind that they don't have to be long-standing or run more than once. If you decide to test a prototype more than once, make sure to regroup and take stock of lessons learned, iterating between each session.

Try testing in locations where the vehicle might travel and your library hasn't ever done programs before. Brainstorm possible locations together with your team. Connect with teachers, business owners, or other stakeholders at the location to coordinate the visit.

Make arrangements for transportation of materials. How are you going to transport supplies without a vehicle? Will you need tables and chairs at the location? WiFi? What support will you need from staff onsite? These are all important questions to ask as you plan for testing prototypes.

You may have to purchase supplies and/or technical equipment for testing. Consider purchasing items that will then live on the vehicle. Select prototypes which you believe will give you the best insights about the vehicle design and future program development. Ensure that staff members implementing the program keep a detailed record of their experiences to share with the whole team at a follow-up meeting.

Case Study

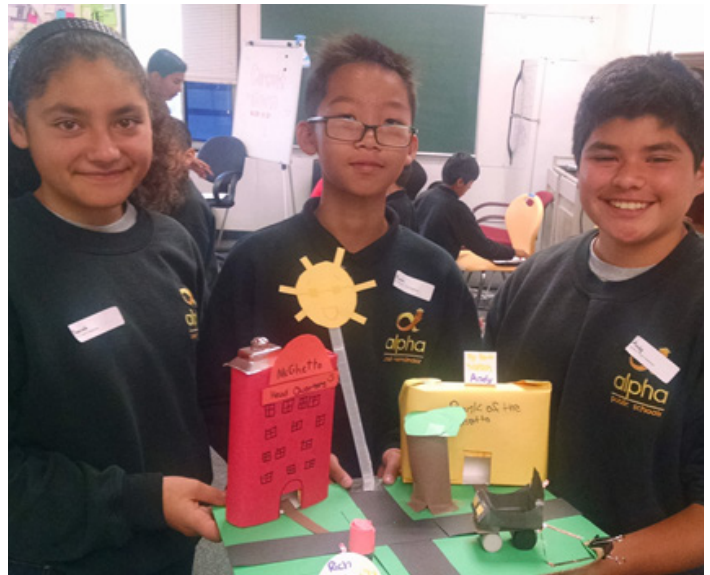
Our team initially decided to prototype programs based around video production. Using the rough prototypes designed in our previous meetings, we began to build the framework for two different programs—one for middle school students and another for teens. A librarian brought the prototype theme to the teen team, having the teens design a program for their peers, including suggested locations.

The staff team decided to host the programs at two locations, a skate park and a middle school. We connected with a teacher at a charter school in a neighborhood we plan to service with the vehicle. She invited us to visit the school to prototype a program with her students. We proposed an instructional video lesson, but she wanted her students to try a non-digital project. Without time for the group to reconvene to prototype again, we selected a program called Circuit Town ([instructables.com/id/Simple-Circuit-Town](https://www.instructables.com/id/Simple-Circuit-Town/)), developed by

SparkTruck, a mobile makerspace from the Institute of Design at Stanford (also known as d.school), and utilized lesson plans available online. A staff team member and the teacher from the charter school had previously explored the lesson together at a workshop hosted by SparkTruck. The staff team felt the Circuit Town program was an appropriate substitute for the video lesson.



With Circuit Town, students were invited to design and build their own cities with the additional challenge of lighting up two of their buildings using paper circuits. Several lessons were learned during this program. First, the space was undefined, making it hard to get students into a comfortable spot to work in their groups. There was also no instructor area, which meant we had to explain things to students multiple times, walking around the classroom and showing them drawings of circuits.



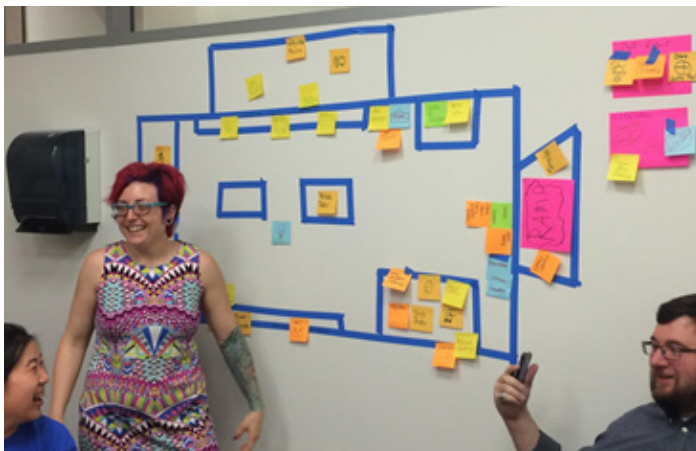


For the second prototype at the skatepark, the team decided to test a video program for teens. Looking back at our empathy exercises, we knew that teens preferred programs which had very little hand holding from staff. To meet this preference, we provided mentors who would be available to guide them when needed. Initially, the team was going to visit the park on a regular weekday. However, the skatepark staff suggested visiting during one of their upcoming tournaments. The staff team came out with tables, chairs, WiFi-enabled laptops loaded with video editing software, and GoPro cameras with various mounts. There was some concern about theft, but this turned out to be a non-issue. Teens signed out the cameras and equipment for thirty minute blocks. While the teens were excited to use the new technology, there was limited time for them to explore the next step of editing and uploading. Since there was an event happening, many had to leave in the middle of edits to participate in the competition.

After testing, the staff team met to share their findings from the events. We discussed what worked well, what didn't, and how the programs might influence the design of the vehicle. It was at this meeting that the teen team was invited to hear the results of the programs and share their own thoughts about the vehicle design. The two teams then went through a prototyping session focusing on the physical vehicle's design rather than programming.

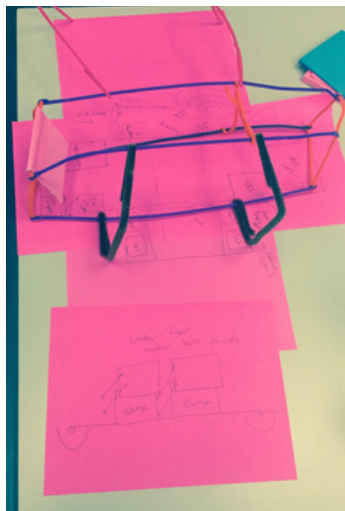
VEHICLE DESIGN

Using the lessons learned from these programs, prototypes, and community interviews, we began the physical vehicle design. We first digested lessons learned from the testing phase. As the staff team told the story of their experiences, we wrote every challenge and opportunity on sticky notes. Looking back at the community interviews and other lessons learned in previous workshops, we then brainstormed vehicle requirements. With a board full of sticky notes, we split into two groups and created designs based on what we had learned, following the prototyping guidelines.



Each of the two groups approached the prototype in a unique way. One team chose to work with pipe cleaners and other 3D objects from our "Design Thinking box" to create the space, while the other team used painters tape and sticky notes to map out the vehicle on the wall. The groups reassembled after prototyping to share their designs and wrote down key findings from each group.

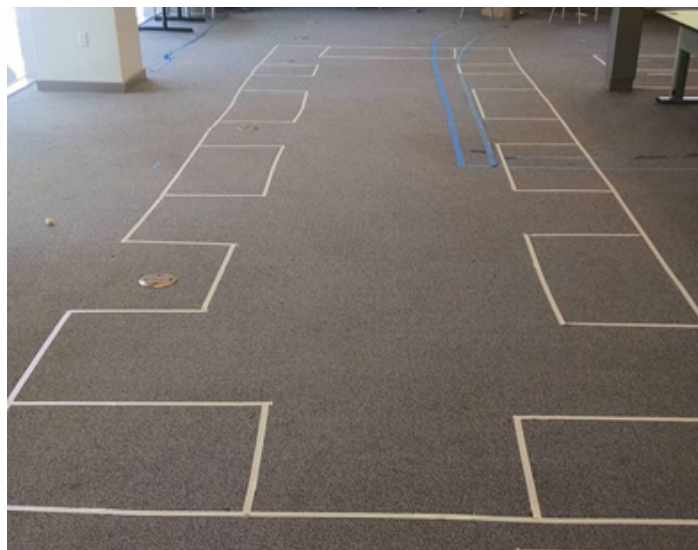
After the meeting, the project manager developed sketches of possible layouts. These sketches and vehicle requirements were utilized during meetings with fleet staff. At live design meetings with fleet staff, we created blueprints of the vehicle that would be used to write the final Request For Purchase (RFP).



Once the first blueprints were created, we made a full-sized outline of the vehicle on the floor of an empty room using tape. This allowed the team to visualize and experience the vehicle spaces: how large the workstations needed to be to accommodate people standing back to back, the best placement of workstations, where the wheelchair ramp could be located, and what the general feel of the vehicle would be.

This process resulted in some changes to the design. These changes were passed along to fleet staff for inclusion in the RFP.

Staffing models will depend on the service level and vehicle size.

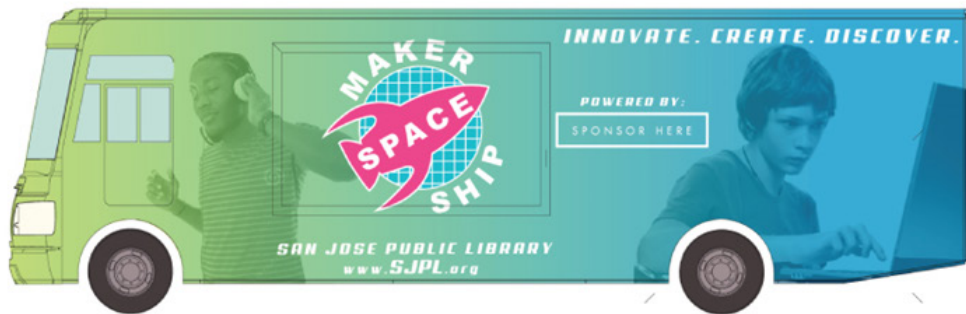


STAFFING

Consider staff that is competent with technology. This doesn't mean they have to know how to use every piece of tech on board from the get-go, but they have to be quick learners. They should be problem solvers, as equipment is likely to sometimes malfunction in the middle of a program. This will be seen as a learning opportunity by the right staff member. Have someone who is energetic, personable, and eager to serve many different populations. If the vehicle is traveling into linguistically diverse areas, it is highly desirable to have at least one staff member speak the language of the population you're serving. Provide staff with training opportunities at local makerspaces or with professionals in the technology field. Allow staff to play and expand their education through trials and experimentation.

PROGRAMMING

Programming models will vary depending on your library's configuration. We wanted to have at least a year's worth of programming options available to us by the time the vehicle launched. While there is already a centralized programming department at SJPL, we wanted a group that was focused strictly on creating STEAM maker programs. We assembled a team of librarians, with skills in designing programming for a myriad of ages, including the manager of centralized programming. This team, deemed the STEAMstacks Programming Committee, based off the STEAMstacks programming model at SJPL, has the mission of designing STEAM programs for the vehicle which can also be adapted for branch use. Considerations for programming included high need and underserved populations, common core standards, available technology, cost, and training/skills of staff or volunteers.



- Our graphic designer created many different options for the vehicle wrap. This represents the first draft of various options.

SPACE BREAKDOWN

THEME

Working in Groups: During our testing at the charter school, we found it was important to have a space that facilitated group work. Work in collaborative teams builds communication, team building, and cooperation skills.

Flexibility: With adaptations in technology and a broad range of programming happening in the vehicle the space had to adapt as required.

Increased Space: A mobile space's biggest challenge is the space available. Consider vehicle features which allow for expanding the space for bigger audiences. The outside of the vehicle can be a second learning space.

Storage: Having easy access to materials and technology is important. No one wants to get onsite only to realize supplies were left in a storage unit back at the library. Building storage compartments into the design increases the options for programming.

Atmosphere: Create a space that is outside of a standard classroom look and feel. This can be accomplished by interior lighting, color accents, furnishing, and vehicle wrap.

Accessibility: Ensure that the vehicle can meet the needs of all patrons, including wheelchair access and workstations.

WHAT WE DID

▶ *5 permanent workstations which fit 3-4 students each:* When doing a survey of vehicles currently operating, we noticed many of them had lab-style workstations with a long bench tabletop. We decided to break this up into 5 individual stations where groups could gather around to work on project together while still being able to see each other. The tables will also allow space to work on individual projects when desired. The station in the back of the vehicle, by the wheelchair lift, is an adjustable height table, allowing participants with disabilities to access a workstation comfortably, while still offering flexibility to allow for standing.

▶ *2 removable work tables:* In the middle of the vehicle are two removable work tables. These tables increase the area for participants to work on projects. Each table will fit up to 5 people. The tables have folding legs so they can be stored during transportation allowing us to add other supplies and furniture for use outside of the vehicle upon arrival at our destination.

▶ *Pop-Outs:* There are two pop-outs on the vehicle, increasing the interior space considerably.

▶ *Awning:* An awning extends on the passenger side, providing shade to outside participants and shading the monitor.

▶ *Equipment workstation:* On the driver's side pop-out, there is a lab-style table to hold equipment that will be permanently installed. This station will house a 3D printer, laser cutter, and desktop CNC machine.

▶ Each of the permanent workstations, other than the adjustable height table, is equipped with storage underneath. Overhead storage cabinets are also located throughout the entire vehicle. The driver's cab has storage space under the table. There is one under bus storage compartment as well.

▶ *Wrap/Interior colors:* The wrap and interior color and design were created to give the vehicle a stunning appearance and create a mood when someone sees the vehicle and steps inside. Bright, bold color choices make the vehicle pop and inspire creativity. One of the teens from the team created a logo which will likely be used in the final design.

▶ *Lighting:* The vehicle has adjustable LED lighting throughout, with lights at each permanent workstation. Having adjustable lighting allows us to customize the lighting for different activities. If we have a movie playing, we can dim the lights appropriately. Color-changing LED strips were also included to create mood enhancement and excitement in the vehicle. One of the themes that kept coming up was creating a sense of awe and whimsy in the space. We wanted a space that felt like anything was possible, and it was outside the standard classroom look and feel.

▶ *ADA Accessibility:* The vehicle is equipped with a wheelchair lift at the back. The wheelchair lift is large enough to allow for equipment to be loaded on and off the bus easily, as well.

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THEME

Multipurpose: With limited space it is important to have areas serve many needs. A driver's seat can swivel to create an instructor station and a wheelchair lift can also be an equipment loading bay.

Technology: Ensure that the space can change as technology changes. Having only a few items permanently embedded into the space will allow for quick adaptation. Make a list of what technology you plan on using in the vehicle and ensure that workstations are equipped as needed.

WHAT WE DID

- ▶ *Driver's cab/Instructor station:* Two seats are available at the front for the driver and one passenger. The seats swivel 180 degrees. There is a workstation for the instructor with a fold-down middle section to allow for a full table.
- ▶ *Green Vehicle:* Having a vehicle that met certain green requirements was important and also a valuable learning opportunity. Solar panels are mounted on the roof to top off the battery when parked. A monitor showing the power of these panels is inside to allow for discussion about solar power with participants. The bus runs on biodiesel, a greener alternative to standard fuel. Where available, materials in the vehicle are made using green/recycled materials.
- ▶ *Sound:* A PA system is wired throughout and has speakers outside, as well. Instructors can play any audio from a laptop or wear a microphone to ensure all participants can hear their instructions.
- ▶ *IT:* There is a robust wireless system with mobile broadband Internet access of 100Mbps and flexibility to expand service levels. Computers are able to join the WiFi network from inside the vehicle and/or outside the vehicle within a 30-yard radius.
- ▶ *Ventilation:* All workstations are equipped with ventilation. This allows students the freedom to do tasks such as soldering without worrying about fumes in a small space.
- ▶ *Monitors:* Each of the five permanent workstations has a 22" monitor with a wall-mounted HDMI input panel. Having the monitors mounted allows for more space on the workstation tabletops. When working on computer projects, participants will be given laptops, which they can plug into the monitor. This gives them dual monitors, or the ability to showcase their work to fellow students and instructors. A large 32" monitor is displayed at the front of the vehicle in the instructor's workstation area. This monitor also has an HDMI panel as well as sound hookups. Using a classroom management system, the instructor can feed their computer to all workstations or switch to an individual monitor via a wireless network. A monitor is also installed on the outside of the vehicle. Since the space can only hold about 25 participants, we wanted to ensure we could expand programs to the outside. Having an outside monitor allows participants outside of the vehicle to view the instructor's lesson, as well. The monitor has a cover to protect it from the elements when not in use.
- ▶ *Projector:* A projector is mounted to the ceiling. There are two pull-down screens in the back, as well. One of the screens is a standard projector screen for showing movies or other images to the whole vehicle, while the other is a green screen allowing for movie making. The instructor will be able to feed any of the computers to the projector.

MOBILE LAB & RESOURCES

FryskLab

fablabs.io/frysklab

Puentek

puentek.com

DHMakerBus

dhmakerbus.com

SparkTruck

sparktruck.org

STEAMtruck

community-guilds.org/steamtruck

TechShop Inside

my.techshop.com/inside

Willie's Woodshop

willieswoodshop.com

Maker Cart

kpeppler.com/Docs/2013_Peppler_Maker_Cart.pdf

GeekBus

geekbus.com

Fleet Digital Arts Lab

fleetedu.com

Science Adventure Lab

adventurelab.org

Mobile Laboratory Coalition

mobilelabcoalition.com/wp/

Makerspace Playbook School Edition

makered.org/wp-content/uploads/2014/09/Makerspace-Playbook-Feb-2013.pdf

Farber Specialty Vehicles

farberspecialty.com

OBS Specialty Vehicles

obsinc.net

Interview Questions

Teens

- ▶ What technology does your school have/not have that you wish you had?
- ▶ What would you like to know more about?
- ▶ What is your favorite technology?
- ▶ What parts of technology are fun for you?
- ▶ How comfortable are you with technology?
- ▶ What problems do you want to solve?
- ▶ How do you use technology with friends?
- ▶ What type of person would you want to facilitate the Maker[Space]Ship?
- ▶ What would attract you to the Maker[Space]Ship?
- ▶ Where would you like to meet the Maker[Space]Ship and at what time?
- ▶ What technology does your school have that you love?
- ▶ What do you wish you learned more about in school?
- ▶ What's your favorite piece of technology?
- ▶ Tell me a story about something you made.
- ▶ If you could make anything, what would it be?
- ▶ Tell me about how you like to work on projects?
 - ▶ Group?
 - ▶ Alone?
 - ▶ Describe the space.
- ▶ What inspires your creativity?

Teachers

- ▶ How do you encourage hands-on making in the classroom?
 - ▶ Tools
 - ▶ Resources
- ▶ What technology do you wish you had at your school?
- ▶ What technology does your school have that you love?
- ▶ What's your favorite piece of technology?
- ▶ Tell me a story about something you made.
- ▶ How can making help support Common Core in your classroom?
- ▶ What kind of support would you like from the library with Common Core and Next Generation Science Standards?
- ▶ What do you wish you could have in the classroom?
- ▶ How comfortable are you with technology?
- ▶ What problem in the classroom would you like to solve?
- ▶ How often would you want to have the Maker[Space]Ship come and give programs at school?
- ▶ What skills do you want students to leave with?
- ▶ Where do you go to find help with technology and/or integrating hands-on learning in your classroom?
- ▶ What inspires your creativity?

Interview Questions

Parents

- ▶ How do you support hands-on learning at home?
- ▶ What skills do you want your child to leave school with?
- ▶ What technology do you wish your child had access to at school?
- ▶ What technology does your child have access to at school that you love?
- ▶ Tell me a story about how you use technology at home?
 - ▶ By yourself
 - ▶ As a family
- ▶ If you could make anything, what would it be?
- ▶ What problem do you want to solve?
- ▶ How could technology and/or hands-on learning help your family?
- ▶ What inspires your creativity?

Staff

- ▶ What professional development do you want/need?
- ▶ What technology do you wish you had at your library?
- ▶ What technology does your library have that you love?
- ▶ What's your favorite piece of technology?
- ▶ Tell me a story about something you made.
- ▶ What technology needs do you see in the community?
- ▶ Where do you go to find help with technology and/or integrating hands-on learning in your programs?
- ▶ What inspires your creativity?

Adult Learners

- ▶ Tell me a story about something you made.
- ▶ How do you think technology could improve your life?
- ▶ What new skills do you want to learn?
- ▶ What inspires your creativity?
- ▶ If you could make anything, what would it be?
- ▶ What technology do you have at home?
- ▶ How do you use technology at home?
 - ▶ Alone?
 - ▶ As a family?
- ▶ Where do you go to find help with technology?