littleBits™ education
THE LIBRARIAN'S GUIDE TO LITTLEBITS & STEAM

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WRITTEN BY TEACHER LIBRARIAN Colleen Graves[1]

INTRODUCTION

Whether you're an educator inspiring the next generation of problem-solvers, a stakeholder involved in developing programs for your community, or interested in facilitating maker activities in your school or library setting, **THIS GUIDE WILL HELP YOU UNLEASH YOUR CREATIVITY WITH INNOVATIVE TOOLS AND PROJECT IDEAS THAT SUPPORT LEARNING.**

littleBits, a collection of easy-to-use electronic building blocks, is a 21st-century learning tool at the intersection of STEM/STEAM and the Maker Movement. As a maker librarian, I find that littleBits is a great way to get students excited about science, technology, art, and math because it makes learning physical and tangible. This guide is meant to help get you started with littleBits and the STEAM movement. You'll get real-world insights from other savvy maker librarians who have done some amazing things with littleBits. You'll also learn how to organize the Bits, guide students through design challenges, create fixed stations in your library, host workshops, build a maker community, and more!

Many studies have shown that playing leads to learning, and the Maker Movement is grounded in these beliefs. In this study[2], scientists found that playing helps children build a better brain by boosting experiences as a foundation for learning. More concretely, playing with littleBits can help students grasp concepts in their more abstract courses. A good example of this is with math.

Practicing math on pencil and paper is very abstract for students because they often have to plug in imaginary numbers and variables. With littleBits parabolas and inverse square lessons, math becomes concrete and applicable with real world values for variables in equations. Experimenting to learn helps learning stick because it is more memorable.

"IS A TINKERER A MAKER ON A RANDOM WALK?"

–SXSWEDU PARTICIPANT, MARCH 2015

GIVING KIDS TIME TO TINKER AND PLAY

Instead of explicitly instructing kids about littleBits color organization regarding inputs and outputs, let students figure out how each Bit functions. Allowing for free tinkering will not only get your students to understand the functionality of each Bit, it will help students build upon these learning experiences once you give them a direct challenge. You'll be surprised what kids learn by tinkering. What's even more amazing is how willing kids are to share with adults about what they've learned while playing with littleBits.

Last year, students at my husband's high school were tinkering with littleBits during lunch. One student suddenly ran over to the principal and said, "Come check this out!" He then taught the principal about how to split a signal and how he could measure the amount of each signal sent to each speaker with the bargraph Bit. He quickly showed her how the energy was dispersed and decreased by splitting the signal and plugging in four more speakers. Once he put the meters on his project, he could see the amount of signal sent to each speaker. The principal asked the student, "Who taught you all of this?" He replied, "Mr. Graves showed me how to plug it in, but then I just started messing around and figured it all out. I wanted to see how many speakers I could add to make my phone louder, but then I quickly realized that it (electricity) didn't work that way."

This is why it is essential that you set aside time in your library for students and patrons to tinker and learn. I held maker mornings last year and made that time about free designing. As adults, we have a hard time with tinkering and giving students time to figure it out on their own. Every one of us has followed a set of instructions to make something, but how many times have we set out to tinker and see what we can discover and invent on our own? For me, teaching my middle school and high school students to tinker is a fundamental building block to molding young innovators. Tinkering is what will lead to the next big thing. Creating and making mistakes—that is how we learn and grow.

ORGANIZING BITS

Librarians love to organize, and how you organize your Bits will determine how much your patrons utilize them. You need a system that is approachable for students, yet manageable for you. Consider the flexibility of your storage as well, since storage for daily use will function a lot differently than storage for an event or littleBits workshop.

ORGANIZING KITS

The Bits come in great packaging, but packaging might wear scars after longterm use. The packaging contains several layers, and makers may not play with what they cannot see. If you only have a few Kits, you might try organizing them by color in small tool bin storage. When I only had a few Kits, I organized my Bits alongside other maker resources in this tool bin organizer. These handy, colorful tubs allowed students to grab the Bits and work anywhere in the library. Some mornings I would hand bins to students and just say, "Stop playing games and make something." One of the main goals in my library is for students to see the library as a place to create and not just consume. These colorful bins made it easy for me to suggest that students create something before school rather than consume video games. They help me turn my digital zombies into creative innovators.

However, you might need your Bits more clearly organized for a guided activity or lesson. This teacher has her Bits sorted into clearly labeled photo storage boxes so that you can see the Bits and they stay organized. A tackle box is another way to make your Bits organized, approachable, and easily viewable. You might even consider storing littleBits Kits in toolboxes so you can make your Bits more portable for circulation.

PHOTO BY Angela Mackenzie of Iris Large Photo keepers containing littleBits

PHOTO BY Colleen Graves
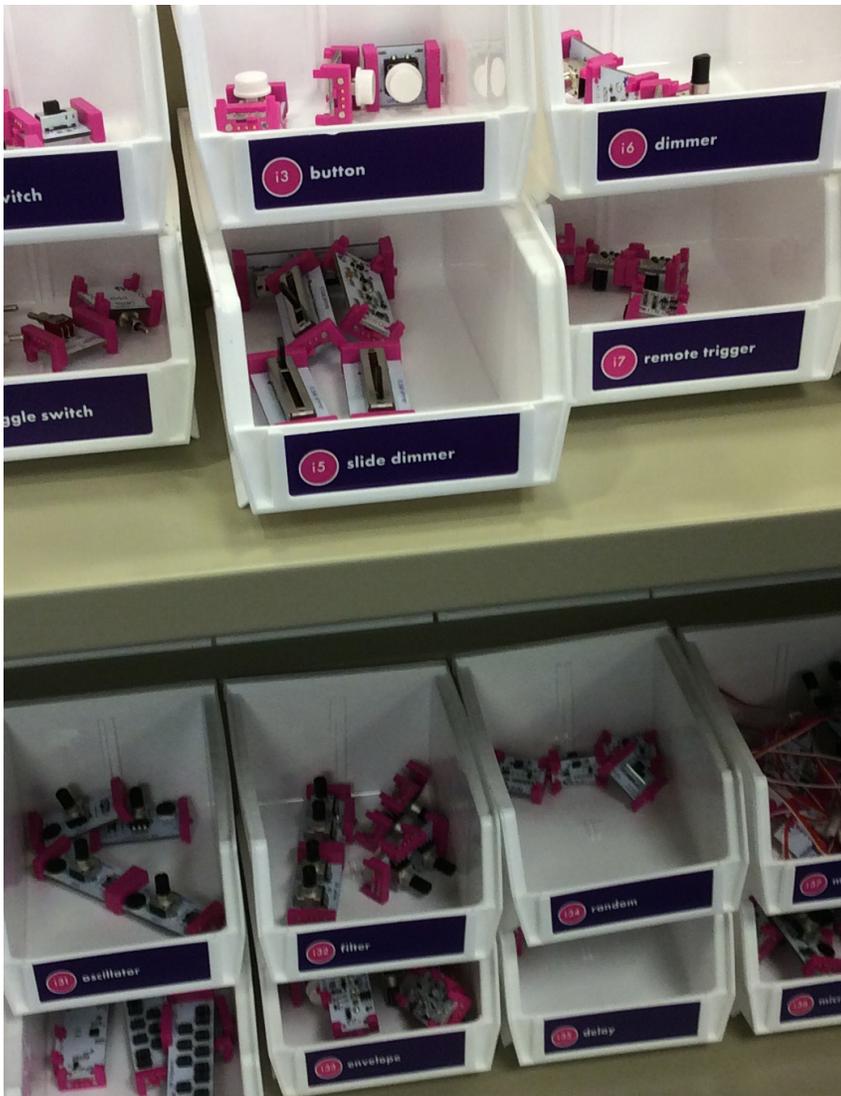
ORGANIZING BITS

ORGANIZING THE WORKSHOP SET

Instead of organizing your Workshop Set in order with power, input, output like the Pro Library, you'll want to organize this set a bit differently. The tackle box has a top layer and a bottom layer so you'll want to store the things you'll need to initially start your project on the bottom. I'd suggest storing power, batteries, and big Bits like the Arduino and Makey Makey Bit here and reserve the top of the tackle box for all the fun tinkering Bits you'll need quick access to while creating. This way you can easily grab your initial pieces like a power Bit and battery. However, the best thing about the Workshop Set tackle box is you can change your organization by project.

UNBOXING AND ORGANIZING THE PRO LIBRARY

The Pro Library comes with its own beautiful storage containers and clear labels, but unboxing it can be a daunting task. First, open all the storage bins and organize them on a book truck. I'd suggest keeping the larger bins set aside until you know what you will want in the larger containers. Once you have all the bins set out, place the labels in bins in order on your cart. Starting with power, then input, output, and lastly wires. Then begin unwrapping and organizing the Bits. All Bits have a letter and number that matches a label. As you put Bits in bins, move larger bins to accommodate larger Bits like the fan, keyboard, sequencer, long LED, IR LED, UV LED, light wire, Makey Makey, Arduino, fork, wireless receiver, and mounting boards. For visual learners, I made a simple 6 second how-to video[3] for unboxing and organizing the Pro Library.

BUILDING A MAKER COMMUNITY

The easiest way to build a maker community is to host school-wide or community-wide design challenges, show off maker creations, and immerse your patrons in maker supplies! Another crucial part of building your community is letting everyone have a part. It is imperative to let some students observe, some create, and allow others to become natural leaders in your makerspace. It is equally important to include students and patrons in decision making. Take stock in what your stakeholders enjoy the most in your space. Do they prefer guided workshops over open-ended projects? Do they have all the Bits they need for their ideas to function? When I asked my students how we built a successful maker community at our school, they were emphatic that involving students in decision making and promotion was the key to our success. By asking teens what they wanted to create in the library and allowing students to advertise with self-made posters, I'd given them ownership in our space. That sense of ownership made them want to come back again and again.

Another key to our success was immersing our school culture and community in maker resources. All of our supplies are out and accessible all day. I was able to secure funding through a PTA grant to purchase the littleBits Pro Library and create a littleBits corner inspired by the fixed station "littleBits Bar"[4] by Laura Flemming. In the front of my library, I placed a tinkering table, mounted the littleBits Pro Library and displayed invention ideas in magazine holders. Students could earn a "littleBits Maker Badge" once they'd completed the initial littleBits challenge cards and learned how most of the Bits worked. This badge gave them access to come to the library and create during their free time. Any student is allowed to complete the challenge and start using littleBits!

JOINING LITTLEBITS COMMUNITY AND GLOBAL CHAPTERS

A library maker community is a must, but you also need to expand your patron's world view by joining the global maker community. Once you've acquired and organized your Bits, make sure you join the littleBits online community. Any time you are stuck, there is a forum you can reach out to for help. If you need ideas on a project or workshop[5], there is a plethora of great resources available on the blog, in the forums, and via global chapters around the world.

Global Chapters are a great way to get your entire community involved in making. If you don't have a chapter in your city, consider becoming a chapter leader. Chapters are a great way to advocate for your space and share the awesome work you are doing in your library. You get your own page where you can upload your patrons' projects and promote your littleBits events.

LITTLEBITS CORNER

The littleBits corner is a cozy space at Lamar Learning Commons Library where kids can be seen and heard tinkering before school, prototyping at lunch, and enjoying learning during their free advisory period. At my new high school, I'm creating a similar space. Since my new library is twice the size, I've placed Bits in a locking cabinet that is open during the day but lockable for after school activities. I've placed clipboards on the wall with various rotating project ideas. The Bits are located by our other makerspace resources and nearby standing height tinkering tables. Kids can grab Bits, plug in the power through a USB cable, and start tinkering! I leave the color bin organizers out at the tinkering table next to the Pro Library so students can tinker as long as possible before going to class and just throw all their pink Bits in one bin, green in another, etc.

I love having these littleBits corners, but I can't host a workshop with 60 kids in either of these spaces. Thankfully, the Bits are flexible. For workshops, I move the bins (but maintain the order) and place them on a couple of book trucks near our classroom area. Depending on the workshop, I'll pull out the main or most-used Bits we'll be working with and place them on our library classroom tables but leave the rest of the Bits on the book truck. They remain accessible to students who want extra Bits to make their ideas come to life.

For example, during our Art Bot Challenge[6], I covered our tables with white butcher paper, put power Bits and DC motors in colorful yellow bins, and then placed various art and craft supplies at the tables. I shared Art Bots from the littleBits website, and my students were inspired by other makers' creations. We did quick sketches, prototyped Art Bots, and tested their functionality directly on my classroom tables. (This is why it's important to have butcher paper on the tables.)

Locking cabinet and project clipboards

More ideas clipped with magnets inside

CORNER VS. WORKSHOP

STORAGE
EASILY ACCESSIBLE

Since some students didn't finish their ArtBots during the workshop time, they were able to place their "in-progress" prototypes on our project shelf–a shelf designated for long-term projects.

PROJECT SHELF

GUIDING STUDENTS WITH
DESIGN CHALLENGES

KIDS, TEENAGERS, AND ADULTS could play with littleBits all day, but at some point you'll need to focus patrons with a design challenge. A design challenge will give your makers a time limit, test their abilities, and most importantly, give them a chance to show off their work. You can make up your own, or join a challenge in the littleBits online community. Some successful challenges include creating a smart obstacle course for programming Sphero robots and creating a game controller for a self-made game. At my library, students were obsessed with the music Bits and weren't really trying anything else out. So I hosted an Art Bot Challenge to incorporate the students' creative side and expose them to more ideas. You could even host an Internet of Things challenge with the cloudBit.

These design challenges also keep students interested by getting them outside of their comfort zones and getting them to try new things. Just make sure you let patrons experiment and give them time to tinker, fail, make, and improve their designs[7].

ONE OF THE BEST THINGS ABOUT THE LIBRARIAN COMMUNITY is the breadth and depth of knowledge and the willingness to share. The following maker librarians offer their tips, lessons, and learnings to help others make the most of littleBits.

DIANA RENDINA AT STEWART MAGNET MIDDLE SCHOOL

Diana is passionate about school libraries being places for students to discover, learn, grow, create, connect and collaborate. She has worked to transform her school's library from a quiet, dusty, cluttered room into a vibrant and active learning space where students want to be. In 2014, she created a makerspace in her library to serve as an informal STEM learning space for her students. She loves to share about her makerspace journey and is enthusiastic to bring others along with her.

STORAGE TIPS

Since Diana has no wall space for her littleBits Pro Library, she took a book display cart and used zip ties to attach the wall panels for her Pro Library. In the future she hopes to add pegboards to the side of the cart to include craft supplies, making it an infamous, multi-purpose makerspace cart. During the day it's stored in lockable storage that serves as a maker room where kids can go and get Bits if they need them.

FAVORITE WAYS TO INTRODUCE LITTLEBITS

Diana introduces students to littleBits with the simple intro video and then leads students through the littleBits 101 task cards. She's also hole-punched the littleBits cards that come with the Kits, sorted them by color, and put each color on a key ring to help keeps the kids' frustration levels low. From there she utilizes the challenges within the Educator's Guide[8] because the kids love to make something that works as an alarm to keep others from "messing with your stuff." Once students have mastered a few simple tasks, she gives students a task while withholding the most obvious Bits. She finds that limiting materials forces them to be more creative.

TINKERING VERSUS GUIDED LEARNING

I asked each librarian what they thought was more important, tinkering or guided learning. According to Diana:

"You need a little bit of both. You can guide tinkering in a way, but you have to be careful about the guidance you give. When you are tinkering you are figuring it out for yourself. It would be easy for teachers to tell people what to do. But when you tinker, you slowly learn what each Bit does. Learning is deeper when you discover things on your own. At the same time, you have to keep an eye out for when people are getting stuck and know when to intervene so they don't get too frustrated. (But still don't tell them; rather push them to think.)"

So a mixture of guided learning and tinkering is a great place for every librarian to start. For adults, it can be difficult to tinker because we are so used to following instructions. Even superstar librarians like Diana have to work on becoming a better Tinkerer. So Diana signed up for the MOOC Tinkering Fundamentals by Exploratorium, and while she worked through the course she posted her learning experiences on her blog[9]. She is a big fan of Mitchel Resnick from MIT's Media Lab, and this quote encapsulates how tinkering leads to deep learning (below).

FAVORITE LESSONS

When asked about her favorite lesson, Diana discussed a student-initiated project. "My students saw a Face-Time car in Popular Science, and decided they needed to build their own. I love watching the process of seeing a student get an idea and then watching or helping them figure out how to execute it." Read more about her students' littleBits FaceTime car on her blog.[11]

FACILITATING COLLABORATION

I also asked librarians if Bits helped to facilitate collaboration between colleagues or even the community. Diana replied, "Yes, one teacher wrote a grant to get more Space Kits to tie in with their space class. Since I have the Pro Library, the kids were able to come to the library to keep working on projects throughout the day."

FAVORITE BITS

Everyone has their favorite Bit, so I had to find out from each Maker what Bit they favored and why. The wireless transmitter and receiver Bits are Diana's favorite because "being able to control your creations wirelessly is really exciting. And it's really good for pranking."

"AS CHILDREN DESIGN AND CREATE, THEY...LEARN NEW CONCEPTS. WHEN THEY CREATE PICTURES WITH A PAINTBRUSH... THEY LEARN HOW COLORS MIX TOGETHER. WHEN THEY BUILD HOUSES AND CASTLES WITH WOODEN BLOCKS, THEY LEARN ABOUT STRUCTURES AND STABILITY. WHEN THEY MAKE BRACELETS WITH COLORED BEADS, THEY LEARN ABOUT SYMMETRIES AND PATTERNS."

–MITCHEL RESNICK From: Computer as Paintbrush: Technology, Play and the Creative Society[10]

DAVID SAUNDERS AT GREENWICH COUNTRY DAY SCHOOL

David Saunders is a Library Media Specialist at Greenwich Country Day School, an independent day school in Connecticut. He is a littleBits Global Chapter Leader and education technology consultant.

STORAGE TIPS

David has built a collection of Bits over the past few years and has them organized in two Workshop Set boxes that are left open in the lab area. He believes in keeping them available to encourage exploration by students and colleagues. The Bits are organized by color and function to make it easy to find what is needed. To get Bits into the hands of teachers, he also checks out the tackle boxes to classes and offers training and instructional support.

FAVORITE WAYS TO INTRODUCE LITTLEBITS

David gives the kids 10–15 minutes of playing when introducing littleBits. Then he asks them, "What have you noticed? What observations have you made about it? What works? What doesn't?" The students' new understandings and persistent questions then provide a roadmap for developing a lesson that is relevant and targeted.

TINKERING VERSUS GUIDED LEARNING

Framing a problem with a design challenge that students need to creatively address is the best way to get students tinkering instead of just making by number. David gives students open-ended prompts, like "Build something that draws something." He instills creative confidence by telling them, "Trust yourself; there is no right answer. Instead, focus on what the questions are that we need to ask to find a solution."

FAVORITE LESSONS

Sixth grade students embarked on a three-week unit focused on learning about circuitry with littleBits. David gave students a challenge to "build something that does something." Over the course of the unit, students brainstormed, prototyped, and rethought their assumptions. They ultimately came up with an amazing collection of projects, including a disco hall, an airplane model, and a lighthouse. In the process, they not only learned about all of the amazing things they can build with littleBits, they also experienced the iterative design process from beginning to end.
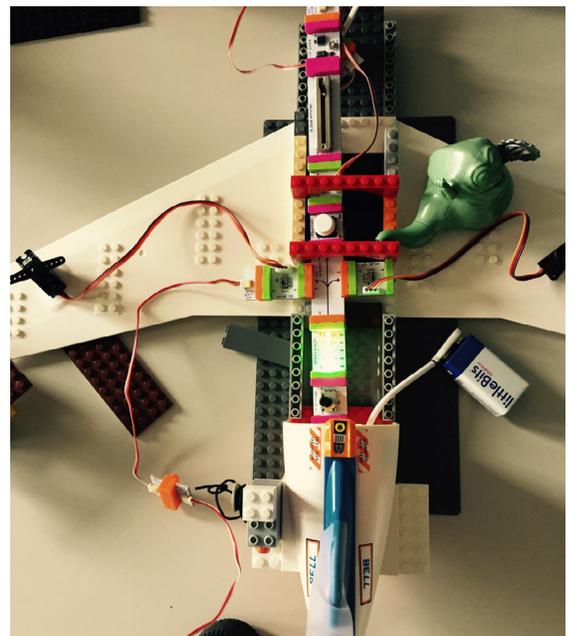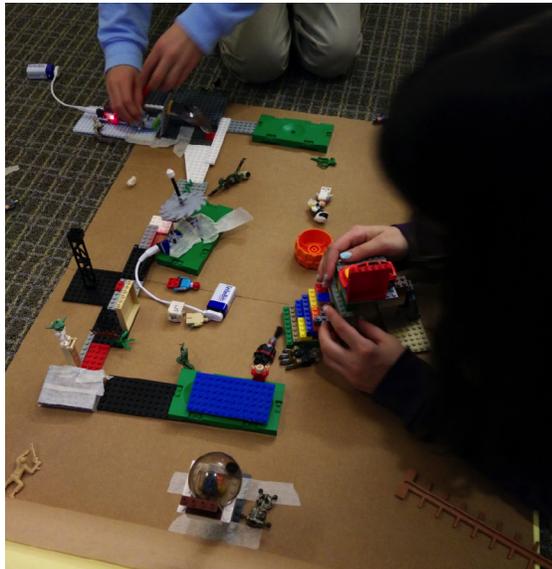
The Game Design Challenge evening event was also very successful. David asked students to create their own game, whether it was a board game, a card game, a video game, or something else entirely. The library was stocked with littleBits Kits, Makey Makey Kits, LEGO bricks, and cardboard, among other things. Students made tabletop adventure games, an airplane simulator, controllers, and a mini-golf course with challenges that needed to be navigated by a deftly programmed Sphero.

FACILITATING COLLABORATION

When asked about facilitating collaboration, David described a recent project: "Our computer class had an electricity project where they design and build a structure or house and then wire it. I'm working on rethinking the electricity project with littleBits. I'll be working in the classrooms to help the teacher launch the project and will be a resource for them as they progress through the unit."
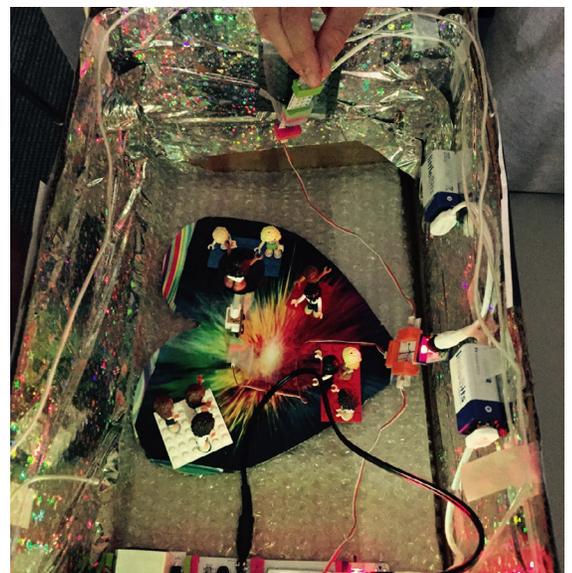
TIPS ON BUILDING A MAKER COMMUNITY

David also offered tips on building a maker community. "You can't just buy stuff," he says. "You need to build the culture. Students need to make decisions about space and purchasing. Ask them, 'How do you want it look and what do you want to do there?' Your library should be an oasis where kids can escape but also mess around and explore. You need to get faculty buy-in and may want to incorporate professional development for faculty."

David also enjoys being a littleBits Global Chapter Leader because he gets to work on awesome projects while meeting new people and sharing work.

FAVORITE BITS

So what is David's favorite Bit? "The cloudBit changed my whole world and the way I play with Bits. Many of my recent projects and explorations have focused on the interconnectivity of my life and devices. And after seeing the incredible project submissions for the Bit Olympics, I'm really interested in building a project that incorporates game play, network connectivity, and fun."

MARY GLENDENING AT MIDDLETOWN FREE LIBRARY

Mary Glendening is the Library Director of Middletown Free Library in Pennsylvania. Createspace@ MFL, a digital media lab and makerspace, opened in 2013 as a pop-up space stored in one meeting room in her library. The project was fully funded through an LSTA Creation Grant. She has added more 3D printers and programs through various grants including 3D Systems MakerLab Club.

Mary started her career at the New York Public Library working in teen and children's services in branch libraries in Manhattan and Staten Island. She earned her MLS degree with a specialization in public libraries from Rutgers University in 1996. She has worked in public libraries in Philadelphia and the surrounding area since 1998.

STORAGE TIPS

Since everything has to be mobile, Createspace@ MFL kept their Bits in their original boxes and then graduated to the tackle box and some storage containers from a Jo-Ann Fabric and Craft store. The library currently keeps their Synth Kits and Space Kits separate and near the digital/audio workstation alongside a green screen so students can utilize the Synth Kits at the workstation. The library will soon be circulating littleBits Kits to the public along with the "Getting Started with littleBits" book. These will be circulated in a heavy duty plastic & canvas bag and the Bits will be in a plastic container with separators inside the bag.

FAVORITE WAYS TO INTRODUCE LITTLEBITS

This summer the Middletown Free Library was able to host a Maker Camp/Girls' STEM Camp. This week-long camp was aimed at girls going into grades 6–9. The goal of the project, called TechniGals, is to get girls interested in STEAM subjects and programs. One of the workshops was a littleBits Design Challenge. During orientation, the girls watched a video of Ayah Bdeir for inspiration. Then each group was given a box to work with. First, girls were given some time to play to see how everything works and how it relates to everyday electronics. Librarians took a few minutes to go to each group so the girls could share their observations about the Bits.

Next, the girls were challenged to improve something you have in everyday life, or create something you wish you had. Craft materials, LEGO bricks, cardboard and additional Bits were available so that the makers could transform their ideas into tangible projects. Everyone was provided with paper, pencils and markers to brainstorm on paper before building. (Some groups did this and others just got to creating.) It was also interesting to see that some groups worked together on one project and other groups worked individually on their own creations. After working for an hour, the girls were asked to stop building so everyone could share and talk about their individual or group projects. Each group or individual explained what they made and showed how it worked. One girl was working on an alarm to remind her to brush her teeth, there was a "do everything" creation, a party machine that blew feathers out of it, and a massage/relaxation creation. The vibrating Bit seemed to be the most popular and almost every project incorporated this Bit into it in some way. The entire workshop ran for an hour and forty-five minutes.

At a separate event, an audio engineer led a three-part workshop with the Synth Kits to learn about sound waves. The engineer explained how the oscillator and envelope work. Then the girls took the knowledge they had from the individual Bits and made a software synthesizer on the computer. This workshop had a small group of kids, aged 6–9. The engineer explained each Bit in an engaging manner that got the kids to think about how it works. After each explanation, the kids and their parents played with the Bit to see how it worked. During the last session, librarians reviewed the Bits, created some sounds, and then moved on to the digital audio workstation. Createspace's visiting audio engineer showed the girls some of the soft synths available, and they then compared the Bits in the Kit to what's available in a soft synth. Finally, they were able to create some sounds on the DAW using the knowledge they gained from working with the Synth Kit.

TINKERING VERSUS GUIDED LEARNING

Mary suggested that you take a step back when you are facilitating and don't interfere too much. Don't give answers, but feel free to guide patrons toward the solution. If someone is getting frustrated, you can offer to work on it together. Simply saying, "Let's learn together and figure it out together," can ease the patron's nerves. It can be a good thing if mom and dad don't want to hang around. In the public library setting, it is sometimes better when parents aren't there because then kids will take ownership of solving the problem.

FAVORITE LESSONS

Mary found that many patrons enjoyed the after school engineering club and working on sound effects with Synth Kits, but many times people just enjoyed figuring out what different things do. She stated, "It's okay for your lesson to go on a completely different tangent. At first you might be nervous, but let the kids take it their own direction. Just start with loose idea and see what happens."

FACILITATING COLLABORATION

I asked Mary if littleBits helped her collaborate with local schools and the community. "Yes, kids came to the maker camp and asked for us to come to schools for club events. Another local school is going to do a mini-maker faire and they've asked me as the library director to serve on the planning committee. The TechniGals camp is our ILEAD USA project (Innovative Librarians Explore, Apply & Discover)[12]."

FAVORITE BITS

It took Mary a while to decide on a favorite, but she remarked, "I love the light wire and I'm interested in using it for a Halloween costume or wearable project."

TIPS FROM OTHER MAKER LIBRARIANS
HOLLY ARNASON: PUBLIC LIBRARIAN

HOLLY ARNASON AT EDMONTON PUBLIC LIBRARY

Holly Arnason is a Digital Literacy Librarian at Ed-monton Public Library in Edmonton, Canada. There are 19 library branches in Edmonton with program-ming for kids and adults. The makerspace opened at the Stanley A. Milner branch in 2013 and is 3000 square feet of awesome. It contains: littleBits, creative media production stations, sound recording booths, 3D printers, an Espresso Book Machine, LEGO bricks, Mindstorms robots, and Snap Circuits. They began circulating their littleBits Synth Kits and a Workshop Set to other branches and now some other branches have their own Sets to use for programming as well.

STORING LITTLEBITS

This summer, participants in EPL's Summer Reading Club were able to earn a badge by playing with littleBits, so the Kits were out and set up a lot during the summer months. However, the public library keeps them put away when not in use in a program. Holly notes, "We want people to use them, but we can't leave them out all day. We are looking into getting some storage where the Bits are secure, but can still be seen. Something like a cabinet with a glass window."

FAVORITE WAYS TO INTRODUCE LITTLEBITS

At EPL, they offer school classes and community groups "Discovery Tours" where they set out exam-ples of many different hands-on activities that can be tried in the EPL makerspace. Staff welcome partici-pants to the makerspace and ask important questions like, "What does it mean to be a maker? What kind of things do you think people can make?"

During a Discovery Tour, the makerspace staff lets kids try things hands-on. A staff member is always nearby to help with learning the language of littleBits (input /output/ branch /power). With students in particular, the makerspace staff emphasizes exploring and helps to guide that exploration with inquiry.

PHOTO CREDIT: EPL\James Cadden

TINKERING VERSUS GUIDED LEARNING

Depending on the group and the goals of their visit, it's sometimes important to guide workshops at first with a focus on providing more context and back-ground information for the public before moving into inquiry and questioning. When staff members are not as experienced with facilitating tinkering, the work-shop might end up more guided. The goal is ultimately to provide an environment where participants can explore, collaborate, and generate ideas and designs. For example, a recent Drawing Bots program for kids 8–12 started with an open brainstorming session. Kids were asked to think of their favorite robot. Then they were asked to sketch ideas and think about what materials they might use to build it. After brainstorming and thinking about their questions on the design pro-cess, the kids began prototyping and designing.

FAVORITE LESSONS

EPL staff have been having a lot of success using littleBits with LEGO, which is great because LEGO at the Library is already a popular program. Some ideas are to challenge kids to build a house that can include littleBits for lights and a fan that can be controlled by switches. Including littleBits in a car design is another great activity.

EPL has also been using littleBits in the Evil Genius Club program and most recently in the Summer Reading Club program "Electric Fun." Several stations were set up: synth, space, and explorer. Students made a Makey Makey dance pad.

During one recent school visit, EPL staff used a paper circuit and a short reading from the classic book Bunnicula to inspire students to create a spooky die-cut bunny rabbit with eyes that can light up. They are soon planning to use littleBits and a motion trigger with the same bunny rabbit craft to create a spooky rabbit that will light up when someone moves!

One of Holly's other favorite projects was when a community librarian and some library assistants visited a summer camp for kids, and they challenged the kids to create costumes and program steps for a robot fashion show using the library's Dash and Dot Robots and iPads.

"The summer camp facilitators were really surprised at how collaborative the activity was," Holly explained. "Sometimes people get the impression that using iPads and similar technology is a solitary activity, but the robot fashion show really got the kids working together to plan and create different costumes — including Harry Potter inspired capes!"

FACILITATING COLLABORATION

So do Bits help facilitate collaboration for public libraries? "At Edmonton Public Library we have a community-led service philosophy, and as part of that, our community librarians work with people in the community where we've identified a need and we see an opportunity to meet that need. It's also a great way to let schools and community members know about our services. For example, we attend or hold programs for newcomers to our city and set up membership drives at large events, like community fairs, where we bring littleBits and our Dash and Dot robots to let people know that the library is more than just books. When teachers see this at an event, they ask a lot of questions and may end up booking a class visit to the makerspace."
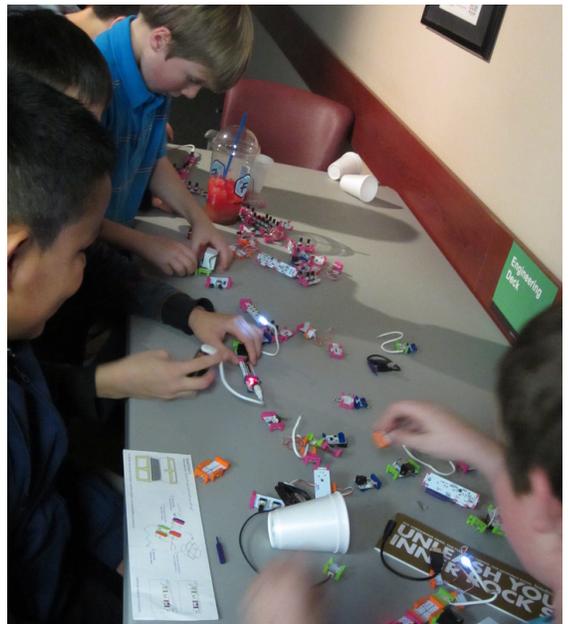

PHOTO CREDIT: EPL\Sandra Sarmiento

PHOTO CREDIT: EPL\James Cadden

TIPS ON BUILDING A MAKER COMMUNITY

Is building a maker community different for a public librarian? "For us, working with our community librarians really helps to build our maker community. Without them, it would be difficult to meet some community members who may not visit the library and gauge their needs. We also have a strong relationship with Startup Edmonton[13], a space for startup entrepreneurs (and our sister, local littleBits chapter), that connects them with space and expertise to bring their ideas to life. Utilizing social media helps a lot as well. We tweeted about our littleBits Drawing Bots program, and it helped us get connected with educators. And it got people in the door!"

How does the littleBits community help? "It's good to join the littleBits online community as well because you have contact with littleBits and are encouraged by their support and troubleshooting. You also get to be a part of this global Community Call where you can promote what is happening in your space and learn about others."

Are you planning any big show and tells? "We are also hoping to host a Community Celebration Day at some point featuring community-made projects. One challenge that we run into with our littleBits programming is that we need to find creative ways to display projects that have been made since people can't currently take our littleBits home."

FAVORITE BITS

Holly explained her love for the bargraph saying, "I love the bargraph because of the way it lights up and has different colors. It's so interesting to use with the dimmer, Arduino, and cloudBit. The cloudBit is another favorite because it's a great technology for being creative–such as designing and pulling pranks. Once I was at a hackathon and I hooked up the littleBits cloudBit to a button and another cloudBit to the buzzer. I created an If This Then That recipe to make the buzzer go off when the alarm was pressed. Then I hid the buzzer on someone's desk and waited until they were working in concentration. I hit the button and, boy, did they receive an alarming surprise!"

CHAD MAIRN AT INNOVATION LAB

The Innovation Lab[14] at St. Petersburg College is more than a makerspace; it is a technology playground where people of all ages can learn new skills and collaborate on innovative projects. Paid for by two St. Petersburg College Foundation[15] innovation grants that are available to staff and professors that have an idea and want to pursue it, the Innovation Lab is chock full of great stuff for students and the public to tinker with and create tangible forms of their ideas. Even though Chad Mairn, the Maker Librarian, serves a school with a large online population, many students come for the 3D printer but stay for the other interesting things including littleBits. He also recently signed on to be a littleBits global chapter leader and has really enjoyed connecting with an international group of amazing minds wrapped around the littleBits project.

"IT'S GOOD TO GIVE THEM A FOUNDATION OF WHAT THIS PROTOTYPING TOOL IS AT FIRST, BUT THEN YOU NEED TO TRUST THEM AND GIVE THEM ENOUGH TIME TO TINKER."

– CHAD MAIRN, Maker Librarian at Innovation Lab

STORING LITTLEBITS

Chad's technology playground has the Synth Kit and Workshop Set. "The Workshop Set is awesome because it comes in a modular tackle box and is like a big suitcase. Since I do a lot of traveling with littleBits, this makes it very mobile," he said.

He likes to keep the Synth Kit in its original packaging along with an inventory sheet to keep track of all of the Bits. The inventory sheet allows him to easily check to confirm that all Bits made it back safely to the Kit as well as check to see if any Bits have wear and tear that need to be replaced. He's considering eventually purchasing a small toolbox so he can circulate his Bits like he does some of the other maker resources available at the Innovation Lab.

FAVORITE WAYS TO INTRODUCE LITTLEBITS

The Synth Kit is a great way to introduce students to littleBits because tinkerers can start making weird, sci-fi-like electronic sounds immediately. Alongside the MIDI Bit, people can control different sounds in software. This means that maker/composers can use a computer to create and control sounds from within a Digital Audio Workstation (DAW) and/or with littleBits.

TINKERING VERSUS GUIDED LEARNING

Both tinkering and guided learning are equally important. Chad finds that it is good to give students a quick overview on what littleBits is and what the Bits actually do because it gives students a signal path to follow. Once they have the basic idea, he'll stop with the direct instruction, hand over the Bits, and let students go. "It's good to give them a foundation of what this prototyping tool is at first, but then you need to trust them and give them enough time to tinker."

FAVORITE LESSONS

Chad teaches classes on sound and building an analog synthesizer[16]. Based on the littleBits guide, Chad teaches students about analog synths while they learn how to control voltage, consequently creating interesting electronic bleeps and beeps. Students find that it's fun to play with frequency modulation. First he chats with students about sound waves and how you can modify/modulate them. Then he explains what a synthesizer is. After the initial guided instruction, he asks students to build their own synthesizer. This guided learning blended with free tinker time allows them to experiment and start finding relationships with music and physics while having fun. The students start to realize that they are controlling voltage and garner a basic understanding of what is inside a synthesizer. Plus, they start making connections with the music they listen to and make new friends as a result. Once they understand what is inside and how you can build your own synthesizer, they begin to understand how a certain electronic sound is made. He also guides student to the understanding of sine waves and square waves so they can see how to play with sound with this frequency modulation technique. He points out a sine wave and displays its pure tone. Then he lets them tinker with adding a square wave. Students love to see how a square wave can add rhythmic structure to the initial sine wave. Chad hopes to incorporate the Arduino Bit soon so makers can visualize the impact the square wave has on the rhythm and harmonics of the pure wave.

TIPS ON BUILDING A MAKER COMMUNITY

He doesn't advertise much, relying instead on word of mouth. Chad is the advisor for his campus Gaming Club, and that group helps spread the word and provides ideas on what to do in the space. He believes the movement is really about getting people together to do things and explore and is not just focused on gadgets.

He learns a lot from his students who have great creative minds. They write invention ideas on the Innovation Lab whiteboard (idea board) and he gives them a gentle nudge by saying, "Let's do it! Let's try it! How will you put it together and when you finish it? why don't you come in and share with others about how you made that? Even share why it worked and why it didn't?" Reflecting on learning is a very important process and creates a virtuous cycle for the maker community as whole. Plus, building our learners into leaders is an important part of maker communities.

FAVORITE BITS

"Right now, my favorite Bit is the MIDI Bit because I can interface my own music software, which is Ableton[17] Live. The MIDI module allows me to integrate that powerful software with the more tactile feel of littleBits. The modular aspect of littleBits gives students physical knobs to turn and twist rather than the intangible knobs on the software. I also loves running the software through the powerful micro-sequencer Bit. But if I had to choose, it's the MIDI module."

TIPS FROM OTHER MAKER LIBRARIANS
MATHEW FISCHER & SARAH PRESCOTT

MAKERS AT SELF DESIGN STUDIO (STUDENT EDUCATION LEARNING FACTORY)

Matthew Fisher is the Director of the SELF Design Studio in the School of Education at UNC Greensboro. He likes to make cool artsy stuff with his hands.

Sarah Prescott is a master-of-knowledge-in-training, otherwise known as a Library Sciences graduate student.

The Self Design Studio[18] is a makerspace for the teacher education program at the University of North Carolina in Greensboro, NC. At this thinklab[19], academic librarians train pre-service teachers to utilize maker tools, and get teachers thinking about how they will tie these resources into the curriculum concepts before they even have their own classroom.

This awesome space has only been open for one year but contains the littleBits Pro Library, Workshop Sets, Synth Kits, Space Kits, a 3D printer, an Adobe Creative Cloud station, Rig-a-ma-jig, a soldering station, clay (both conductive and insulative), art tools, airbrush, Dot and Dash, a laser cutter, and more. As part of the Teaching Resources Center, School of Education students have access to borrow littleBits, Makey Makeys, and 3D printers to use in their student teaching classrooms.

STORING LITTLEBITS

The SDS stores their Bits in original packaging and has two Workshop Sets in tackle boxes. They have one Workshop Set available for checkout, but a teacher must also attend a series of workshops before they check it out.

They also use their Deluxe Kits and Synth Kits in the space daily, but they've taken the directions out so that teachers have to figure out the directions themselves. The Pro Library serves as a resupply, but also as a place to get extra Bits for projects.

FAVORITE WAYS TO INTRODUCE LITTLEBITS

Matt and Sarah love to hand makers a smallish pile (mostly Bits from the Deluxe Kit) and offer no guidance or instructions at first. Instead, they tell them, "Go!" After a few minutes of tinkering, they ask the makers what the colors mean, and then focus their activity by then handing over challenge cards. Matt and Sarah made some challenge cards based on the basic guide, but they have a flap for suggested circuits if the makers need a hint on what to do next.

TINKERING VERSUS GUIDED LEARNING

So how do these academic experts feel about tinkering and guided learning? "Both are good," Matt says. "Last week we gave teachers four different stations. At each station, they had figure out what to do and build something. If people were struggling, we nested people in groups so they could guide each other. It worked really well. We have step-by-step directions available, but most people will go their own way."

FAVORITE LESSONS

When asked what about great lessons for academic makerspaces, Matt recounted the #InventAnything[20] challenge from last spring. "We challenged students to reinvent a work of art, and we made this littleBits motion painting."

Matt and Sarah usually guide makers with a few questions and thoughts, like "What is this? This is littleBits. Here are some basic circuits and some basic projects. Now, pretend you are going to a dance party, and create something to wear."

The most interesting thing, these librarians note, is giving two groups the same challenge and seeing where they take it. During the share out, the makers are asked why they solved their challenge in that way, so they have to explain their problem solving.

Since students can work on their own projects during their free time, many cool projects and prototypes are tested in the lab.

During a "Hack Your Backpack" challenge, a student designed her littleBits "hackpack" to sense the temperature. If the weather was warmer than 75 degrees, the littleBits fans will turn on to cool off this innovative student.

During Scratch Day, in May of 2015, students worked with the programming language Scratch in many different ways. One station was a littleBits area. A plugin for Scratch allows students to use Scratch programming blocks to program the Arduino Bit. A couple of students worked with this enough to recreate the classic Pong video game using the slide dimmer as the controller.

When work in the Studio first began last fall, one School of Education student came in with a problem related to her dog. Megan's dog, Blue, was constantly drinking from the toilet bowl. To keep her dog out of the bathroom, the SDS team prototyped a Makey Makey with the protoboard, mp3 player, speaker, and alligator clips. When Blue stuck his nose in the toilet, the mp3 player would trigger as a circuit from the toilet. The mp3 would play a message to tell Blue to get out of the toilet.

TIPS FROM OTHER MAKER LIBRARIANS
MATHEW FISCHER & SARAH PRESCOTT

TIPS ON BUILDING A MAKER COMMUNITY

Last year, as part of a School of Education mini-grant, local middle and high school students who are deaf or hard of hearing were invited to the UNCG SELF Studio. These young makers were challenged to create a deaf-friendly home by incorporating technology that would improve their daily lives. Each student made a model house from foam board, balsa wood, and other art materials. Each student was issued a Deluxe littleBits Kit which they used to create devices for their models.

In many deaf homes, there are no walls so that communication is easier for the family. But this does not allow for much privacy. Using the DC motor and push button Bit, one students created a wall that would come down from the ceiling to give her a private bedroom space. Several students utilized the vibration motor in the bed as an alarm system.

One great way that the Self Design Studio is building a maker community is by helping set up makerspaces at local schools. These super star makers also offer "quest" classes, where they turn the makerspace into an interactive game. Makers then earn points by completing different quests with different resources. This is in addition to assisting professors with teaching units on making in teacher methods classes.

To raise awareness about the makerspace and its availability to students as a resource, the SDS conducts various open house days offering free workshops on name badge creation, synthesizer creations, and 3D printing.

FAVORITE BITS

What Bits are the favorite of this academic duo? "The wireless Bits are my favorite because the teaching resource center is always helping me out," Sarah explained. "I can set up a wireless Bit over there, and a buzzer over here in the SDG. That way we can communicate with each other."

NOW WHAT?

NOW THAT YOU'VE GOT SOME WORKSHOP IDEAS, ORGANIZATION TIPS, AND LESSON IDEAS, what is your next step? First, organize your Bits and get them out for your makers to start innovating! Then host a workshop or create time in your library for tinkering with Bits, but the important thing is to get started. As quick as you can, unleash these powerful Bit that support learning and get your students or patrons on the path to innovation.

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12 It is an IMLS funded project taking place in ten states this year. The program kicked off in Illinois last year and has expanded. Each team, consisting of librarians from at least two types of libraries, identifies a problem in their community that can be solved through technology. Our library has been running maker programs for several years but have found that it's been a challenge to attract and retain girls. Our partner in the ILEAD program is a librarian at Penn State Brandywine. They are looking to re-launch a program aimed at middle school girls to get them interested in STEM careers and majors called STEM options. This project offers an opportunity for us to come together in a common goal and to forge a working relationship to make programs successful both in our library and on their campus."

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THANK YOU.