Good afternoon. I’m Melendra, the Youth Consultant for the North Central Kansas Libraries System, a group of more than 40 libraries in Kansas. Today, I’m going to talk to you about creating mobile makerspaces.

As noted in YALSA’s “The Future of Library Services for and with Teens,” “Today’s teens are part of an increasingly global and competitive society. Success in that environment requires an expanded set of skills that includes learning and innovation skills (such as creativity and innovation, critical thinking and problem solving, [and] communication and collaboration)” (pg. 3). Such skills can be encouraged through Maker activities that allow teens to participate in connected learning. While, many of you may dream of adding a makerspace to your library, many libraries are intimidated by Makerspaces feeling that they don’t have the resources, space, or expertise to create one in their community.

Librarians have addressed this issue in a number of different ways. Some have added making to their other programming; some have created tiny maker areas; and some have started sharing resources with the branches and libraries around them. The North Central Kansas Libraries System falls into this last category. We decided to create circulating makerspaces that can be checked out by the libraries in our system.
I didn’t have Christie Gibrich’s questions in front of me when I was considering the creation of mobile makerspaces, but when I read them, I realized that these questions succinctly capture the information I collected in order to justify the creation of my Makerboxes. I’m sharing Gibrich’s questions now, because as I built this presentation I used them to keep me focused on the information that impacts the creation and use of the makerboxes within my library system. And I think they’ll be useful to you as you create your own mobile makerspaces.
NCKLS had a number of system wide goals in mind when we created our circulating makerspaces. Broadly, we wanted to allow our libraries to experiment with the maker movement and expose their patrons to this re-envisioning of library space. We wanted to do this in a way that allowed the librarians to try out a lot of different technology and tools without having to spend a lot of money themselves. We wanted them to understand that makerspaces can be built using a wide range of resources and utilizing varied plans, spaces, and budgets. Also, we hoped that by providing the makerspaces in a circulating format we would inspire the librarians to experiment with new topics and stretch their skills.

Another essential goal was that the libraries begin to host more programs for tweens and teens. I work with libraries in communities ranging in size from 150 to 40,000 people, with most of the populations below 1,000. Many of the libraries are staffed by one person who doesn’t have children’s or teen experience, money for material, or time to plan programs, and convincing these librarians to plan and perform teen programs is understandably challenging. Many of the libraries don’t have a teen area or a teen collection. So, if the makerboxes motivate libraries to expand their teen services, they fill a significant hole. Finally, we hoped that the makerboxes would help our libraries build local partnerships.

Of course, like all libraries and library projects, we have limitations. We have a fixed budget, and as often as possible, the resources we provide need to be materials that can be reused. Our makerboxes are transported long distances, and the items in them need to be durable and replaceable. Finally, since the makerboxes circulate to libraries of all sizes and librarians of all level of technology skill, the materials in each cannot have too steep a learning curve and need to be flexible enough to use for a variety of programs.
When I started this project, I brainstormed ideas for what sorts of mobile makerspaces would fulfill our requirements, searching online for maker crafts that were both cool and not too complicated, and considering the pros and cons of reusable versus consumable items. I wanted the makerboxes to be more than craft projects. While I believe that crafting is making, for these makerspaces I wanted to push the boundaries into more of the STEM zone, focusing on science, technology, engineering, and math.
Over the next 2 years, I created the makerspaces listed here because these themes can be used for events that focus on different types of making. Each of the makerboxes contains theme related physical items that are mobile because they are transportable. I transport and store all the materials in 66 quart Rubbermaid tubs, which are both very sturdy and can hold a lot of stuff. I secure the lids with plastic zip ties when I send them to libraries via a statewide courier or on our rotating collection van. When they aren’t checked out to a library, they live in a closet in my office where they are all stacked on top of each other. It’s not the most convenient setup when I need a makerbox from the bottom of the stack, but luckily, they are checked out a lot.
All but the LEGO makerboxes contain at least 7 books related to the program theme. The makerboxes also include multiple projects and the supplies necessary to make them, as well as binders with activity and idea resources.

Within these binders, I've included information about the 40 Developmental Assets for Middle Childhood and Adolescents from the Search Institute as a reference for the librarians. This resource describes building blocks of development for young people and how adults can support youth and help them grow up into healthy, caring, and responsible adults. Each makerspace also includes an evaluation form for librarians to fill out after their programs. I use these evaluations when I add or remove materials and projects from a makerbox and to help me build new makerboxes.
This list is an example of the types of activities and ideas I include in the makerboxes to help librarians when they’re planning a maker program. There are recommended websites for both active and passive program elements, suggestions for movie tie-ins, images of sample projects, and specific directions for activities.

Ideally, the Activities and Ideas resources make it easy to plan an event or to set out pieces of the makerspaces as passive programs which empower patrons to follow their own interests, working at a pace that is comfortable to them.

Instructables, Make, and other do-it-yourself websites are great resources for finding activities with clear directions. Also, I ask the librarians to add their own ideas and suggestions from the programs they presented when they send the makerbox back. Not only does this “grow” the makerbox over time, but it also encourages some collaboration and buy-in on the part of the librarians.
Another system goal for the makerboxes is that they will help our libraries expand their teen collections. By including books in the makerboxes, I hope to encourage our librarians to become more familiar with teen books at the same time that program attendees are exposed to books their library might not currently collect. I encourage the librarians to use the books in the makerbox as part of promotional displays prior to and during maker events they host, or add a short read aloud element to their programs. Each makerbox contains a list of links to book trailers for the included books so that librarians can promote books they may not be personally familiar with.
The makerboxes circulate for a 2 month period and contain multiple projects. This gives the librarians choices when they checkout a makerbox, but it also means that if the library has an ongoing club that focuses on a theme, they could use a different project from one makerbox for each session during those 2 months.

When I started building my makerboxes, I focused on self-contained projects that have all the pieces and parts included in one box. This made sense both for how I was envisioning the makerspaces and for the early makerbox themes. Self-contained projects are easier to transport, restock, and usually come with some directions that the librarian and patrons can reference when they are working on a project.

The activities I selected are often a mix of consumable and reusable items. All consumable materials are replaced by NCKLS as needed. However, we reserve the right to ask libraries to replace any non-consumable materials that are damaged or missing when they return a makerbox. We’ve yet to need a library to actually replace any thing.
Because the books included in the makerboxes are all theme related, I selected a mix of old and new books from a variety of genres. Initially, I searched for only books that fell squarely into those marketed by publishers as teen books, but I promptly discovered that finding exclusively teen books for many of my themes was more difficult than I expected. So, I started looking at books marketed for other ages that have teen appeal. I used Baker & Taylor and Amazon for much of my research, as well as Good Reads, YALSA’s Best Books lists, other award lists, and review journals.
As I made the makerboxes, I quickly started adding projects that were not self-contained. For the solar makerbox, I included the materials for the creation of a mini-solar oven made from mostly recycled items, like a router box and leftover laminating film. The activities and ideas pages for the solar makerbox include instructions for creating a variety of solar ovens, suggestions for programs that test the cooking temperatures of these ovens, and tips for cooking s’mores in a solar oven. Information about other renewable resources is also included.
Because the projects in the Circuits makerbox are more free form, I made sure that some of the included books provide ideas and instructions to help librarians and teens as they select and create projects. Librarians can use the books to prepare for the programs in advance, or the librarian can be a co-learner with patrons as they explore the projects together. Having instructional books in the makerboxes can expand a program by providing extra activities, and including nonfiction books allow participants to follow their own interests if they fall in love with a certain type of making. Giving children and teens the resources to make their own discoveries provides them the opportunity to practice critical thinking skills without the pressure of tests and grades.

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<th>Circuits</th>
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<td>• Ashes by Ilsa J. Bick</td>
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<td>• Jolted: Newton Starker’s Rules for Survival by Arthur Slade</td>
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As the makerbox projects became less self-contained, I ended up purchasing more supplies for projects. For example, because the circuit makerbox has a LilyPad Arduino, it also needs a LilyPad power supply, conductive thread, fabric, sewing needles, embroidery hoops, needle-nose plyers, and LEDs. Figuring out what supplies I needed for each project was sometimes a challenge, as with my LilyPad example when I thought I’d purchased everything only to discover that I didn’t have a way to upload code to the LilyPad because I was missing a cable and connector.

Alternately, some projects had overlapping supplies, which resulted in nice cost savings when I purchased materials outside of prepackaged kits. I also had to decide what items I wouldn’t supply, for example, the circuits makerbox does not include the conductive and nonconductive clay necessary for the Squishy Circuits activities, although it does include the recipes for making each.

The makerboxes provide occasions for community outreach, such as when one library joined a local Mini Maker Faire by hosting a MaKey MaKey music station or when another librarian partnered with a local high school English class using squishy circuits to let students build character symbols out of clay and LEDs.
The Mini Weapons makerbox was my first foray into a kit that has no self-contained projects. The activities in this makerbox are all found in the included books and are created from inexpensive office and home supplies or recycled materials. Because it isn’t possible to include all the materials for every idea in the books, I highlight some of the simpler projects in the activities binder. But, I encourage librarians to give themselves and their patrons time to browse the books and find the mini weapon that speaks to them personally.

This makerbox is one of a handful where participants in a program are likely to go home with a built object. As is common with many makerspace models, most of our makerboxes contain projects that patrons help to create but do not get to keep. This reusable aspect of the makerbox items is part of what makes them cost efficient.
This makerbox is fun, in part, because it can be used for programs focused on making the mini weapons, like this event at which participants built catapults and tested the distance and accuracy of their shots. Or it can be part of a larger program at which homemade weapons stations are a perfect addition, like a Hunger Games or zombie apocalypse program.

I mentioned earlier that I used Amazon extensively when finding the makerbox books. I also ordered most of my project items through Amazon. This meant easy returns if things were damaged and easy reordering when I need replacement materials. Amazon’s “wish list” feature allowed me to create lists for each makerbox and have the cost of the materials approved prior to purchasing.
The books in the builder makerbox are all idea focused: no instructions and no fiction. In part, this is because it was quite difficult to find books related to a builder theme with teen appeal, but mostly it is because, when I tested this kit with tweens, I discovered that getting them to build boxes and towers was easy but getting them to think creatively about building other things took some initial inspiration.
My big discovery for this makerbox was the stl file of connector pieces that I printed using a 3D printer. The connector pieces allow patrons to build using any combination of LEGOs, Lincoln Logs, Tinkertoys, K’nex, and Bristle Blocks. Since all of these products are out of copyright, the file is an opensource document. Providing the connectors opens the individual products up to a wider range of imaginative projects.

The builder makerbox is perfect for building challenges, like the Bridge challenge during which participants make bridges from the materials on hand and test them against each other’s creations for things like strength, length, or height. Such events are a great opportunity to partner with a local architect or an architectural department at a college or university.
I created 2 Photo Booth makerboxes, because the first was so popular. Photo Booth 1 has photography related fiction, while Photo Booth 2 has how-to books for using your phone or tablet to take interesting, artistic photos, as well as some prop design books.
The Photo booth makerboxes include a small photo printer that connects to smart phones and tablets. They have fabric for backdrops and premade photo-props, like masks, mustaches, and hats to set up a photo booth. Finally, they include supplies to make your own photo props.

To my mind, the photography aspect is what qualifies these as makerspaces, but they get used for all sorts of tween and teen programs. They’re very versatile because they can be used by themselves to teach photography techniques and layouts or as an element of almost any program, from superheroes, to book characters, to no shave November.
Not surprisingly, the Repurposing Books theme was the easiest one to find books for, so this makerbox's books represent a fun range of genres. To be on the safe side, I've added a note stating that the included books are not for repurposing, but I offer to send weeded items from our rotating book collection along instead. However so far, all my libraries have their own weeded materials to use.
The Repurposing Books makerbox supplies mainly consists of the tools necessary to make something new out of a book, such as craft knives and needle-nose pliers, although special project provisions, like wire and toothpicks, are included. This is perhaps the least STEMish makerbox in the collection, but many of the crafts, such as origami and book safes, require teens to utilize mathematic and spatial reasoning, and use skills like patterning, structural thinking, measuring, and design.

The Repurposing Books binder is crammed with images, directions, and links because there are hundreds of tutorials and designs available for repurposing books. Some of the most popular take a considerable amount of time and patience, but the makerbox is also perfect for shorter projects like origami bookmarks and baskets or passive programs like black-out poetry and paper collage poetry.
The Break It reMake It makerbox is designed around taking apart computers, hence the computer, coding, and hacking theme demonstrated in this list of books. This makerbox is a perfect example of how having mobile makerspaces available for teens gives young adults access to tools and resources they might not otherwise have. We all know that not everyone has a computer, but even fewer teens have access to a computer that they can take apart just so they can play with the internal pieces. Such hands-on experiences spark teen thinking while resource links included in the makerboxes allow for self-directed learning and make it easy for them to explore as deeply as they wish.
When I circulate the Break It reMake It makerbox, I offer to send a computer tower or laptop to take apart, but as with the weeded books I mentioned earlier, my libraries usually have their own computers they are looking forward to destroying.

This makerbox contains both the directions and tools for safely taking apart a laptop and a desktop tower as well as putting them back together again so a library can have a program focused on computer repair or discovering how computers are built. The makerbox also includes the necessary materials to create earrings, bracelets, and necklaces, among other crafts, for teens more interested in making new things out of the computer’s guts.
Each of the 4 LEGO makerboxes contains a copy of The Unofficial LEGO Builder’s Guide and one other “idea” book as well as a Lay-n-go mat/bag and 5,000 LEGO pieces. The LEGO makerboxes have extensive lists of LEGO challenges to inspire programs. Not surprisingly, the LEGOs have been so popular that many of the libraries who’ve checked out these makerboxes have then started successful LEGO clubs. Perhaps more surprisingly, many of these clubs were started with donated LEGO, because when patrons saw the LEGO kits in use, they realized the library would be happy to take their children’s outgrown LEGO out from under their feet.
In addition to building and creation programs, LEGOos are perfect for stop motion animation programs and make-your-own game programs. In between LEGO events, the teens’ creations can be displayed around the teen area, or the LEGOos can be used for passive programs. One such passive program is a community build during which patrons can add to a project a few pieces at a time over the space of a week or a month.
Now that you’ve had an overview of what’s in each of the NCKLS makerboxes, we’re going to take a break from the PowerPoint. I’d like you to form groups of 4 to 6 people to brainstorm passive programs that you could throw using the NCKLS makerboxes. To add some complexity, throw in a STEM requirement.

I’ve got a handout for each group that lists the contents of the makerbox you’ll be using. We’ll spend about 5 minutes brainstorming ideas before we come back together to share ideas with the group.
Great! Now that we have some ideas, remember, you don’t have to be the expert. In fact, the makerboxes provide a perfect opportunity for the librarian to be a co-learner with the patrons or to partner with the broader community to bring in an expert. Exposing youth to resources and contacts in the community will enhance their academic and career prospects. You can look to local community colleges, universities, unified school districts, or even job training programs to find STEM and maker expertise. Beyond the educational world, members of military and service organizations are good partners both as knowledgeable presenters and as prospective financers for a maker program. Clubs like Rotary International and the Lions Club International have members from a variety of educational and business backgrounds, so you might find partners for a wide range of programs in one club.
Sometimes local and international youth clubs seem like the easiest place to start when you’re considering partners for juvenile and teen events. Boy Scouts and Girl Scouts have STEM and Maker movement focused opportunities and activities. And, if you are in an area with an active 4H community, they are a wonderful resource with a STEM curriculum and educational kits. They are, by far, the club partnered with the most frequently by my librarians.

This is a good time to mention that although NCKLS checks the makerboxes out only to system librarians, the makerspaces can be used by other organizations within a library’s community. If a librarian wishes to share a makerbox with a community partner, the library can do so. Sharing the makerboxes as a community resource is a great way to build or strengthen local partnerships. We do ask that when a library lends a makerbox out to a 3rd party, the library takes responsibility for any damaged or missing items when the makerbox comes back to NCKLS.
One of the fabulous things about the maker movement is that there are lots of different people and groups that are interested in it, which means lots of opportunities for creating partners and volunteers out of individuals in your community. People with hands-on, interactive interests, hobbies, or jobs can be great partners for putting on maker programs within the library.

Partners can provide the expertise and possibly resources, while the library provides space and additional resources. Or, if the tools and equipment a program will focus on aren’t portable, perhaps the expert provides the space too, and the library provides marketing and additional staff.

Partnerships with individuals introduce youth to a broader segment of your population and let them experience some of the tasks available in different careers, greatly expanding chances for connected learning. Additionally, such programs give the volunteers a different perspective on, and help them build relationships with, children and teens. This can build community support for youth library programs and provide children and teens with new role models and mentors.
Our second activity focuses on partnership opportunities. Stay in the same groups, but use a new makerbox, and brainstorm programs that you could present with a community partner. Consider what the library would provide and what the partner would provide. There is a space on the forms to list the program as well as the partner you’d collaborate with. Again, we’ll spend up to 5 minutes brainstorming ideas before we come back together to share those ideas with the group.
Since their creation in May of 2014, the 13 NCKLS makerboxes have circulated 87 times to 24 libraries. The makerboxes seem to give our all-purpose librarians more confidence in presenting tween and teen programs. Many of them have told me that the mobile makerspaces are both helpful and big time savers.

In addition to our libraries using the makerboxes for programs, since the makerboxes were introduced, I’ve seen an increase in requests for consulting related to teen topics, such as building teen collections, ideas for other teen programs, marketing to teens, creating teen advisory boards, and maintaining positive discipline with teens.

We’ve also seen a significant increase in interest for makerspaces and STEM materials and ideas. Some of our libraries have purchased 3D printers and Sphero robots, while others have experimented with paper circuits, build your own games, and stop motion animation programs.
Because we started small with our makerboxes, and focused on inexpensive or reusable materials, my administration has provided funding and encouragement for the creation of new makerboxes, as well as providing the funds necessary to replace items within existing makerboxes as needed.

Currently, I’m in the process of creating 3 new makerboxes: a Rube Goldberg Machine makerbox, a Coding makerbox, and a Stop Motion/Movie Making makerbox.
Before we wrap up, I’m going to quickly share some things other libraries are doing with mobile makerspaces. These are makerspaces that are shared between libraries in systems, schools, and as state resources.

1. The Arrowhead Library System in Rock County, Wisconsin, has maker kits with a mix of high and low tech options, from LEGO and Play-doh kits to kits with tablets, Spheros, sewing machines, and heat guns.

2. The Ed Tech Team at the Blue Valley School District circulates their Tinker Tubs to the library media specialists at each of their buildings. Classroom teachers who wish to use the Tinker Tubs are encouraged to collaborate with their school librarians.

3. The Illinois State Library created 9 maker kits using a Knight Foundation Prototype Fund Grant. Any library in Illinois can borrow these kits through Interlibrary Loan.

4. The Knox County School District created four mobile makerspace carts that rotate among their four middle school libraries. The makerspace carts dock at a library for nine weeks at a time.
Thank you for coming to my session. I hope you were inspired and gathered some good information. Feel free to contact me if you have more questions about this presentation or the NCKLS makerboxes. Again, I will post the ideas that we shared along with my slides on the ARSL conference site.