STEM* PROGRAMMING TOOLKIT

(*Science, Technology, Engineering & Math)

Created by: STEM Resources Task Force

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STEM Programming Toolkit

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About the Kit

This toolkit was created in 2012 - 2013 by a task force of the Young Adult Library Services Association (YALSA). YALSA would like to thank the members of the task force, who include: Erica Compton (chair), Julia Driscoll, Jennifer Knight, Laura Mesjak and Tiffany Williams.

About YALSA

The mission of YALSA is to expand and strengthen library services for teens. Through its member-driven advocacy, research, and professional development initiatives, YALSA builds the capacity of libraries and librarians to engage, serve, and empower teens and young adults. YALSA is a subspecialty of the American Library Association, the world's largest and oldest library organization, and a financially stable 501(c)3 not-for-profit.

To learn more about YALSA or to access other resources and guidelines relating to library services for and with teens, go to www.ala.org/yalsa.

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Sample citation

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Overview

The purpose of this toolkit is to provide library professionals and library workers who work with and for tweens and teens with materials and resources for professional development, outreach, collections, and programs to successfully integrate Science Technology, Engineering, and Mathematics (STEM) into programs and services.

What is STEM?

STEM stands for "Science Technology Engineering Math." The acronym is used to refer to those areas of study which encompass a wide range of sciences. The last decade has seen an increase in STEM education and programming at all levels. This is partly as a result of understanding that students are not receiving the math, science, and technology education they need. The 2006 Programme for International Student Assessment (PISA) ranked the scientific comprehension of American students 21st out of 30 developed nations.

STEM in Education: A Brief History

Jennifer Hopwood provides this concise background in her article for the Summer/Fall 2012 issue of *Children and Libraries* entitled, “Initiating STEM Learning in Libraries”:

The term “STEM” was first used in political sectors in reference to jobs related to science, technology, engineering, and mathematics. In 2006, George W. Bush proposed an initiative to target funding for STEM resources and academic programs to address the shortfalls witnessed by graduates in the STEM fields; part of this plan also addressed K-12 science and math education support and focus 1.

For the next several years, STEM education remained a focus of agencies like the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF). Focusing on STEM education became a law in 2007 with the signing of the America Competes Act. However, STEM really made headlines in 2011 with the reauthorization of that law 2. Education groups and businesses across the country embraced STEM, including the American Library Association (ALA).

This focus continues with President Obama’s “Educate to Innovate” campaign which seeks to “improve the participation and performance of America’s students in science, technology, engineering, and mathematics (STEM).”

Why Should Library Workers Pay Attention to STEM in Education?

Over the last 40 years the United States has seen a sharp decline in the number of students who pursue degrees in STEM fields. In 1966 84% of STEM doctoral degrees were awarded to U.S. citizens. In 2004 that number was only 59%. In 2009, American teens ranked 23rd in science and 31st in math. At the same time, the U.S. Bureau of Statistics estimates that STEM jobs will grow twice as fast as other fields. Even jobs that are not strictly in STEM fields will require technical skills. As a result, both the government and the foundation /nonprofit community are directing funds at STEM efforts in order to reverse the trend.

Many libraries, whether by conscious effort or not, already provide some support to tweens and teens in the area of STEM, but are probably not seeking out the available grant funding to support it. Yet libraries are in a good position to help young adults gain key skills in STEM areas. By providing fun programs that incorporate STEM ideas,

libraries can spark an interest in their young adult patrons and demonstrate to the community the important role the library provides in helping prepare teens for a 21st century workforce. Libraries already offer access to the tools necessary to pursue STEM projects such as computers and devices, and Internet access, which young adults may have only limited access to at school and may not have available at home. Public libraries often have more freedom in programming options than schools, and can help to fill some of the gap American youth are experiencing in STEM education. With fewer restrictions on time and content, public libraries in particular can provide the opportunity to experiment, allowing tweens and teens the time for trial and error. There are no grades or formal evaluations for students in a public library, which allows for a stress-free environment to play and find inspiration.

Reports on STEM

The increased interest in STEM education has resulted in a number of useful studies and reports that libraries may find helpful when making the case for new STEM initiatives.

- "Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5": was prepared in response to a request by a bipartisan group of Senators and Members of Congress who asked the National Academies to respond to the following questions:
    - What are the top 10 actions, in priority order, that federal policymakers could take to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century? What strategy, with several concrete steps, could be used to implement each of those actions?
- STEM Education Matters: Resources, Stats and Infographics: A website containing resources and statistics from many different areas.
- Teach.com Infographic: Teach.com has put together an infographic highlighting the beginnings of the STEM focus in America, the decline in STEM interest, and its recent resurgence as we strive for global competitive advantage through mastery of STEM research and education.
- The National Afterschool Association has begun aggregating quantitative data showing that "high-quality afterschool programs have a significant impact on student engagement and pursuit of STEM fields." --from *Afterschool: A Vital Partner in STEM Education.*
- STEM Reports compiles cutting-edge research and articles on STEM education - all in one place.
- At The National Center for Education Statistics you can find the report entitled "The Nation's Report Card: Science in Action: Hands-On and Interactive Computer Tasks From the 2009 Science Assessment".

- A new study published in *Psychological Science*, a journal of the Association for Psychological Science, goes beyond the classroom to examine the unique role that parents can play in promoting students' STEM motivation.
- Generation STEM: What Girls Say about Science, Technology, Engineering, and Math: This report by The Girl Scout Research Institute addresses the continuing challenges women face in STEM careers, and offers support to girls who want to put their interest in STEM into action.

Getting Started

You realized there is a need in your community for STEM programs and you have an idea of what you would like to offer to the tweens/teens in your community. Now it is time to start planning your STEM initiatives! Planning is one important step you can take to insure that your program is a success. However it is often glossed over and not given the attention it deserves. The planning stage is where you can delve into the every aspect of your program from - marketing to evaluation - and think through exactly what you will need to implement a successful initiative. Outlining measurable outcomes and objectives as part of the planning stage will help drive the process and make it easier to measure success. The Afterschool Alliance has compiled evaluation report data from STEM programs across the country. This document useful for the wealth of support documentation showing the positive effect of STEM programs and can also help you craft your list of desirable outcomes to the programs you plan!

Creating an Action Plan

Using an action plan to help plan and implement your event can be invaluable. It forces you to think through all of the steps required to host a successful event. The Toolkit provides a template to help guide you through this important planning process which can be found in the Appendices.

Identifying the need and using these to create program goals is a good place to start your planning. Next, inventory your existing resources such as current staff expertise, potential partners, and school support. You may have more resources available to you then you realize if you systematically review these steps.

Once you have your project goals outlined, it is time to break the project down into manageable steps and assign the resources required to complete them. The action plan is particularly useful for this piece of the planning process. Think in terms of “What needs to be done? When does this need to happen? Where will this take place? Who will complete it? How much time or money will it cost?” Answering these questions for each step will give you a much better idea of the scope of the project. Once you have filled this section out, you may realize that you do not have enough time to implement the project as you envisioned. That’s alright! Think about how you can scale it back to a more manageable project.

Next, take the time to write a project description on your action plan. You will find that it can help focus your ideas and streamline the project. Have a fellow staff member read the action plan and provide feedback. If it is unclear to them, it may be that you have a

section that needs more thought or details included. Another reason to have a comprehensive description is that it can help you create the marketing message you need to draw those tweens and teens in the door. Believe it or not, you have to sell this program, event, or project to your teens! Successfully marketing your project is a big part of ensuring that you have those tweens and teens show up.

Finally, create a list of all of the materials, technology, software, and other resources that you will need to implement the project. Try to think of everything you will need to do the project from start to finish. Even though it takes time to create an action plan, it is worth the effort.

Take a look at Appendix A and begin filling it out with relevant details as you work your way through the toolkit and develop your program. An example of an action plan has been included in order to give you an idea of the type of information that is useful in creating your action plan.

Need another example of planning an event? Take advantage of YALSA's program planning template on the Teen Read Week™ and Teen Tech Week™ websites at www.ala.org/teenread and www.ala.org/teentechweek. Not only are there great ideas on the YALSA website, but the program planning template can prove invaluable.

Making the Most of Your Budget

When it comes to programming, cost is a major consideration. Many institutions believe they can't afford to fund extravagant programs. Partnerships can help offset costs. (See below for information on partnerships.) Furthermore, not all STEM-oriented programming has to be expensive. Larger programs can also be funded by money acquired through grants from institutions that are supportive of the library's mission. Here are a couple of resources that might help:

- STEM Grants features news, updates and a free downloadable guide to STEM (Science, Technology Engineering, and Mathematics) educational grants for K-12, educational non-profits, and universities.
- Afterschool Alliance has created several resources you may find useful:
    - A list of funding resources,
    - The Guide to STEM Funding for Afterschool, and
    - A toolkit designed to help educate leaders and the public through advocacy. This toolkit can help you make a case to stakeholders about the importance of including afterschool programs in STEM education reform efforts.

Ideas for Any Size Pocketbook

One low-cost activity you might try would be to implement a weekly challenge for your tweens. Set up a display with books on bridges and a tub of building bricks like Legos™. Ask them to build a bridge that will hold a certain amount of weight using only the materials provided. Don't have building bricks? Paper can be folded to create building units too! The idea is to get your tweens and teens engaged, having fun, and using STEM skills - sometimes without even knowing it!

So, you have a bit of money to spend? Great! Check out the Roller Coaster Ski Jumps program below. It won't blow your budget, takes about an hour, and also makes use of commonly found recycled objects.

If you have a larger budget available, consider a multiple day project to engage your tweens and teens during a spring or summer break. This provides you with the opportunity to delve deeper into a subject and have a final day challenge or competition. Think about the fun the tweens and teens could have learning about simple machines if they know that they get to create a trebuchet or catapult to toss an object as far as they can! Kits are available for purchase, or you can have kids make their own using scrap wood and found objects. Another option if you have a bit of money to spend, is to purchase something like the Extreme Machines Summer Camp kit from PCS Edventures! The kit is designed to have everything you need for a group of 25 tweens and teens. They have kits for every age and for every STEM area you could ask for so have fun exploring their site.

As you can see, whatever your budget, there are lots of fun and interesting program ideas you can implement. Be sure to check out the sample programs below for more ideas.

Partnerships

You don't have to go it alone! Partnering with another library, school, or organization helps you in several ways. It builds relationships and strengthens your library's ties to the community; spreads the workload and sometimes cost; demonstrates your library's strengths, and can spawn new ideas through collaboration.

There are a number of smart steps to take to lay the groundwork before contacting a potential library partner. The California Library Association has compiled a great checklist of steps.

- Before choosing a partner, have a clear understanding of your program goals, what is needed to reach them, and how a partner can help your library meet these needs and achieve these goals.
- Be clear both about what you hope to get from a partner but also how a partnership will benefit the partner organization.
- Going forward, establish the lines of communication, document everything, and be prepared for anything.
- Publically thank your partner organization and stay in touch because you may want to work together again.

Ideas for Local Partnerships

You don't have to live in a big city to find suitable partners. The possibilities for local STEM related partner organizations are limitless.

- If you are a public library, involve your local schools by getting the teachers on board with collaborative lesson plans. You can work with school library professionals on coordinated physical and virtual displays of STEM materials. Is

there a popular science teacher that would present an exciting experiment in the library? Promote your programs through the parent-teacher associations and get school administration excited about community-wide STEM activities. Don't forget your community colleges, colleges, and state universities. Invite professors into the library to show off their research projects or start a regular Science Cafe. Maybe the university has interesting or unusual items you could interlibrary loan for a visiting exhibit.

- Both Boy Scouts of America and Girl Scouts of America have badge requirements at all age levels that fit a STEM curriculum. Contact local troop leaders to offer your assistance to the troops in completing these requirements. Or ask them for their help with planning and presenting programs. Providing community leadership and volunteering is a big part of both organizations' missions.
- Consider partnering with an afterschool program such as the National Association for Afterschool Activities. Not only will these groups have a following, but they may also be able to cost share. You can find out more about your local afterschool group by checking out
- Contact a science or children's museum in your area. Take advantage of the work already being done by these STEM experts. Maybe you can arrange for an in-library science demonstration or the museum can provide your library with curriculum materials they have already created.
- Many communities have arboretums, gardens, nature or wildlife centers. Invite a naturalist to come and talk about your area's natural history, native species, and how your teens can be good stewards of the earth.
- Is there a state or federal research facility in your area? Think about the businesses in your community that fall under the STEM umbrella--medical or dental professionals; computer programmers, electronics repairers, actuaries...Inviting adults in to talk about the work that they do and the educational path that got them there could inspire teens who are curious about career choices.
- You may have astronomy, biology, computers, even science fiction clubs already exploring STEM topics through the local park district or school. Invite these teen experts into the library to share their excitement with their peers.

  These are just a few ideas to get you started thinking about who you could approach in your area!

National Organizations Emphasizing STEM

Looking beyond your own backyard, there are a number of national organizations that can help you:

- The Midwest Girls Collaborative Project (MWGCP) brings together organizations throughout Illinois, Kansas, and Missouri that are committed to informing and motivating girls to pursue careers in science, technology, engineering, and mathematics (STEM).

- Science Matters is an electronic network initiated by the National Science Teachers Association and implemented in Illinois by ISTA to foster communication, collaboration and leadership among science educators. Through this network, teachers and other science educators are provided with information about professional development opportunities and science teaching resources.
- American Society of Mechanical Engineers
- Teens Turning Green a student led movement devoted to education and advocacy around environmentally and socially responsible choices for individuals, schools, and communities.
- The National Afterschool Association supports "increasing high quality science, technology, engineering, and mathematics (STEM) learning opportunities for children and youth during out-of-school hours." Online resources available at their *STEM - The Year of Science* website.
- Lunar and Planetary Institute offers a program called *Explore*, which is designed to enable library professionals to bring NASA Earth and space science information and activities into their youth and family programs. *Explore* currently offers nine educational modules ranging in topics of investigation from ice on Earth and in the solar system, astronaut health, the Moon, Mars, Jupiter, and space exploration.

Marketing and Promotion

Expenditures of money and time will mean nothing if no one shows up for the programs you plan or makes use of the collections you make available. "It's also crucial to consider how you can position your programs and services within the STEM context. By doing this, you'll let people in the community know you are well aware of this key educational focus and help them to start thinking of teen library professionals as aware of, involved with, and keeping up on current issues in the education world." (from "The Lowdown on STEM," by Linda W. Braun) We must target the audience we intend to serve and work to insure that our message is delivered. When planning your STEM program, include ample time to publicize both before and after your program using your library's publicity protocol. Below are some links to how you can get started.

- Library Success is a best practices wiki for libraries that includes a page for marketing tips, links and success stories.
- Anastasia Goodstein offers some pretty sound advice for attracting today's tech-savvy, multi-tasking teens to the library in her article What Would Madison Avenue Do? Marketing to Teens: To attract today's teens, think like a marketing pro

Take a look at YALSA resources and publications. As mentioned, both Teen Read Week and Teen Tech Week™ have extensive planning guides. The ALA Store also carries a wide range of books geared at helping you deliver successful programming initiatives, many of which have thorough planning guides.

Phyllis Davis, Head of Youth Services at Matteson Public Library, Illinois, suggests that STEM programming should be clearly branded as "STEM" programming aligned with Common Core Science curriculum. She also suggests that libraries be clearly identified as vital partners with educational institutions in your community. "Don't say that you and your staff are not teachers. Think of yourself as an informal educator and your library as a site devoted to supporting lifelong learning opportunities."

As with any programming or publicity, consider how to incorporate young adults into the process. Teens who are engaged in the planning and publicity process can be your best advertisers-if they feel invested in the program they are likely to tell their friends and encourage other people to come. If you have a teen advisory group or volunteer corps, think about how you can include them in your marketing efforts.

Evaluating Your Program

You planned a dynamic STEM program, secured funding, created community partnerships, promoted widely and thoughtfully, and you had a room-full of teens having a great time with STEM. So you are done, right? Not so fast! Remember that action plan? You had desired outcomes, objectives AND a way to see if they were met, right? Be sure to remember to implement the evaluation step of your program. It might include a short survey for teens as well as a tool that allows you to be reflective about the program and the process. A variety of evaluation examples can be found in the Appendix.

Perhaps even more important than collective evaluative data is having a game plan for what to do with it after you are finished. We've all carefully collected data sit in a manager's inbox, on a shared drive, or in a binder. The point is to use it. Have a plan for what you will do with the data; who you will give it to, what point you're trying to illustrate, and how you will collate it in a time effective way that will enhance your programming. Figure out the "so what?" before collecting the data-so that the evaluation you are collecting is tailored to what you need.

Looking for more information? *Evaluating Teen Services and Programs* by former YALSA president Sarah Flowers offers more information on how to get started (Neal-Schuman, 2012. http://neal-schuman.com/etsp). You may also want to look at the California Library Association's outcome-based summer reading project, which offers timely insight.

Surveys

Getting participants to complete a quick survey on their way out the door is a great way to get in-the-moment feedback, as well as contact information to invite the teens back for the next round of amazing STEM events! They are easy to create and implement. They can, however, provide limited types of information so use other tools when you can to gather more substantive data.

Informal Evaluation Tools

It is important to keep your eyes and ears open during your program so you can “catch” the teens sharing great stories or ideas. You might hear them talk about how the program relates to school work they are doing, or how it has made them think about a career in a STEM related field. When you hear teens sharing information like this, ask a follow up question or two and be sure to jot down some notes. How a program affects a teen’s life is another powerful way to evaluate the results of your program. Collect transformational stories to share with your community. These can help demonstrate the value of what you are doing and make a wonderful presentation to the library board or to trustees wondering what impact the library has on the community. Remember to take pictures too. (Be sure to follow your library’s policies regarding releases, of course.) I picture really is worth a thousand words!

Creating a Rubric

When it comes to evaluating a STEM program, you will have different expectations than for other programs. The focus of STEM programs is to teach something concrete to participants, such as a skill or a concept. A rubric is about evaluating specific outcomes, which makes is a great choice for evaluating STEM programs. It makes sense to look at your action plan when creating a rubric. Decide what factors and results are the most important to your evaluation needs. If you are trying to build attendance at programs, it makes sense to include this on your rubric. If you are trying to teach a skill, then determine several levels of competency that apply to that skill. For example, if you are hosting a program using Scratch (a free coding language/program that allows users to attach pieces of code to each other, much like Legos, to create stories, games, or videos), you might want each participant to create a finished product by the end of the program. The different levels of success would depend on the number of participants who met this goal. Other possible measures might include interest, measured by the number of questions asked during the program, by a rise in circulation of STEM materials directly following the program, or by answers to a questionnaire; the performance of a speaker, by how accurate their talk is and how they incorporate relevant activities; or any other measurable outcome that you can think of. Having your rubric ready ahead of time will remind you what you want to focus on, and will also help you plan your program.

Next, you need to decide on what levels to include. The levels can be descriptive (Excellent, Standard, Poor). You could also decide to use a point system, awarding 1, 2, or 3 points at each level. Don’t limit yourself to only three levels. For some evaluations, it may make more sense to have four or five levels of competency. The following sample rubric is for a program about Scratch. Scratch has ten types of code within the program, including motion, looks, control, operators, and variables. These pieces of code are combined like building blocks to create a video or game.

Outcome	Excellent	Standard	Poor
Attendance	Attendance at this program was higher than average.	Attendance at this program was average.	Attendance at this program was below average.
Use of STEM components	Relationship between program and STEM is clear from the content	Relationship between program and STEM needs explaining.	There is no relationship between the program and STEM.
Participants showed competence with Scratch	All participants were able to create a story/game/video using the Scratch program.	80% of participants were able to create a story/game/video using the Scratch program.	Less than 80% of participants were able to create a story/game/video using the Scratch program.
Participants used a variety of coding types within their project.	Participants used an average of 7 or more coding types.	Participants used an average of 5 or 6 coding types.	Participants used an average of 4 or less coding types.

A rubric will be easier to use if you make sure to use specific words and ideas rather than general ones. General words to avoid using include some, many, few, and good. If a word requires interpretation, decide how you will interpret it and change the wording to reflect that interpretation.

To see example rubrics, check out these sites:

- Rubistar allows you to create your own rubric from a template. Because anyone can upload their rubric to this site, not every example will be perfect, but they can help you to identify what you want to measure. The blank template is a good way to get started.
- teAchnology provides rubric makers specific to the sciences.

Sharing Your STEM Stories

OK, you are almost done. Now it's time to get the word out again. But this time share information about your successful STEM initiatives and programs in order to make sure the community understands the value that the library is providing (and so that others in the library community can learn from them!).

Make sure your library's administrator, board and staff are aware of the exciting work you are doing and why it adds value to the library. Pin up photos in the break room and

provide your supervisor with talking points and photos that he or she can share with the library director, trustees, school principal, etc. Share a press release and photos with the local paper. Share information with partners, funders and policy makers. Letting the public and the library community know about how you're helping teens with STEM is very similar to any other type of public relations, but there are a few specialized places you might want to consider promoting your programs.

Linda Braun's *Being a Teen Library Services Advocate* offers more advice and ideas about advocating for teens and libraries (Neal-Schuman, 2012. http://neal-schuman.com/btsa).

STEM SPECIFIC SITES

- Are you a member of LinkedIn? Share your stuff on their STEM in libraries or the STEM Learning in Public Libraries group.
- Add your story to the YALSA STEM Wiki.
- Don't forget the wider library community--we are always looking for good ideas! Why not write a short blog post, share on a listserv, write an article, or present at a conference. You can find suggestions on where you can get the word out to other young adult library professionals on the YALSA website, Get Involved and Share with YALSA.

PATRON STORIES

Many libraries use stories directly created by patrons to provide feedback to the community about their programming and services. This kind of tool can be used for your STEM programming as well.

- The South Central Library System in Wisconsin created a project called Libraries for Real Life. They are collecting stories from patrons using a simple web-based form. Patrons can upload photos along with their story, bringing their words to life.
- The Metropolitan Library System in Oklahoma has a beautiful site designed to showcase stories that patrons have shared.
- The Maine State Library has created a web-based form that allows patrons to share their stories about the impact the library has had on their lives.
- Afterschool Alliance has a "storybook" format to tell the stories of people and communities transformed by STEM afterschool programs.

Best Practices

This section covers best practices related to STEM programming. Several ideas on what constitutes "best practices." are incorporated. Whenever possible, strive to incorporate one or more of these into your program.

The following was adapted from a presentation given by Phyllis Davis, MLS of the Matteson Public Library at the Illinois Library Association Conference on October 10, 2012.

When considering best practices for library STEM Programming, it may be helpful to think of the term "STEM" as an interrelated group of fields.

- Science can be considered the research arm of the group.
- Technology is the tools portion of the group including both the tools to do research and to analyze results.
- Engineering encompasses the designing of practical applications to what is learned.
- Mathematics is the language used to describe the results obtained in the research.

How can public libraries incorporate STEM education into their services? Public libraries are considered informal learning environments, as opposed to schools which are formal learning environments. The 2010 report titled Surrounded by Science: Learning Science in Informal Environments (Fenichel, M., and Schweingruber, H.A. (2010). Surrounded by Science: Learning Science in Informal Environments. Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.) This contains a summary of studies on best practices for learning science in informal environments. Although it specifically relates to Science Learning, much of it can also be applied to the other STEM related fields. It's available for free in a PDF format on the National Academies Press website (http://www.nap.edu/catalog.php?record_id=12614).

Informal learning environments can be divided into three main categories.

- Every-Day Learning Opportunities:
    - Talking at the Dinner Table about Climate Change
    - Watching a Television Program on Robots
    - Reading Books for Fun about Computer Animation
    - Web Surfing for the Latest Tech Toys
- Designed Spaces for Independent Learning (e.g. Museums, Zoos, Aquariums, Visitor Centers, and Libraries)
    - Drop In Stations where Teens can Mix and Manipulate Music
    - A Pathfinder About the Solar System
    - Creating a Makerspace in a Library or Other Facility for Independent Use
- Planned Activities Offered at Designed Spaces or Community Organizations (e.g. After-School Programs)
    - Any STEM Programs at Your Library
    - Classes Held in or about Your Makerspace (e.g. on 3D Printing)
    - A Homework Helpers Club where Older Students Mentor Younger Ones in Math or Science, etc.

Public libraries can be an integral part of all three of these categories.

Despite differences in the learning environments described, they share common characteristics which encourage and facilitate learning.

1. Learners are engaged in multiple ways, including physically, emotionally and cognitively.
2. Learning is driven by the learner's interests.
3. Learning experiences are multifaceted and dynamic.
4. Experiences build on prior knowledge and interest.
5. Learners have control of how and when they learn.

The report also describes science learning as collaborative in nature. True science learning requires much more than simple memorization of facts or the knowledge of how to design and complete basic science fair projects. A framework of six strands of learning has been developed to identify the science-specific capabilities that can be supported in informal environments.

1. The activity or lesson provided should spark interest and excitement about the topic covered.
2. It should provide an understanding of specific scientific content and knowledge.
3. It should allow for the student/ participant to engage in scientific reasoning by observing, questioning, testing, and refining to make sense of the topic studied.
4. The activity should allow for reflection on the science based both on a student's personal background knowledge as well as the science information provided in the lesson.
5. Activities should allow for use of the tools and language of science.
6. The activity or lesson should help the learner identify with the scientific enterprise. The learner should come to think of themselves as a science learner who both learns about science and contributes to the science learning of others.

This framework uses the inquiry-based learning model. Many science programs found in public libraries use a demonstration-based model where there a scientific principle is demonstrated and each participant then creates a project to take home. Current research illustrates that students learn more deeply if they have engaged in activities that require applying classroom-gathered knowledge to hands-on real world activities. For example, don't create clay volcanoes & make them explode using baking soda & vinegar. Instead, talk about how acids & bases react to each other then test how different kinds of liquids react to baking soda to make predictions about whether they are an acid or base. Next confirm your experiment results with litmus paper. Discuss why your results do or don't match what you see on the litmus paper test. Research also shows that inquiry-based experiences are not so much about seeking the right answer but about developing the kinds of creative problem-solving skills and innovative thinking that are being sought in 21st century jobs and are required even for decisions related to everyday living in our increasingly technology-based lifestyles.

The challenge of a greater emphasis on inquiry based learning is that classes take more time to plan and require adults to give up some control of the class to the students. Classes should introduce a challenge for students to solve using the materials provided and their own creativity. Emphasize that there can sometimes be more than one

solution. Solutions are tested, evaluated, and redesigned and retested. When an experiment fails to meet expectations it can often be a great learning experience where students learn the most about scientific principles by discovering first-hand what doesn't work.

Another good practice is to be well informed about the field of Science Education. To this end please see the document published in February 2011 by the National Research Council: A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. It is available in PDF free of charge on the National Academies Press website (http://www.nap.edu/catalog.php?record_id=13165). This is document that the new common core standards for science will be based on.

Some General Suggested Ideas:

1. When talking to involved adults consider calling your STEM programming "classes" rather than "programs" to cement the association in the minds of the public that this is a free educational opportunity which supports science curriculum and which in many areas has been slashed due to the mandates of standardized testing. The connotation of classes also inspires teens to dream of future careers in STEM fields. All of this also adds to the value that taxpayers see in the use of their tax dollars at the library.
2. Design your programming with the idea of creating a habit among the participants of coming to the library regularly for classes. As teens develop a habit of visiting the library for STEM activities that they enjoy, they will also be more likely to use the library's other services.
3. Older students enjoy design challenges to support interest in engineering. Give them supplies and tell them what to build with it, but not how to do it. Take this idea a step further and have teens design an engineering challenge to present to younger students. Take teens from participant to partner in your STEM programming.
4. Students will be more focused if they have a specific job to do. Consider the roles below:

Student Roles for Collaborative STEM Activities in Small Groups:

Obtained at the Museum of Science and Industry (Chicago), Science Minors After-School Clubs Associate Level training, Fall 2011.

1. Materials Coordinator: This individual is responsible for collecting the materials for the group and returning them to the teacher when the activity has concluded.
2. Instructions Supervisor: This individual is responsible for being the group expert for the procedures to be followed to complete the activity. If there is a need for clarification, this person is to consult the teacher/facilitator to review and clarify.
3. Data Collector: This individual is responsible for recording the data that the group collects in the course of performing the activity.
4. Diplomat: This person is responsible for visiting other groups and both observing their progress and discussing, finding, and bringing back information to the group.

5. Presenter: This person is responsible for taking group findings and reporting them to the entire class.

More About Best Practices

In "The Lowdown on STEM," Linda W. Braun states, "Once teen library professionals are aware of what STEM is all about, it's possible to join the conversations, and articulate the role the library can play. That role can be through providing materials and/or offering curated resources, classes, and out-of-school-time programs." She lists the following examples:

- Classroom connections: Analyze your collection for the resources and programs that can support STEM, and remember it doesn't have to be just the math or science curriculum that you want to support. Make connections via other subjects as well, such as history or language arts. Maybe there's a fiction title with a scientific connection or a biography of someone involved in STEM-related work. What about your books on cooking, or car repair, or music?
- Content curating: How can you help organize content available through the library within a STEM context? Maybe it's creating a web-based LibGuide, LiveBinder, or perhaps by curating news at scoop.it. Consider the possibilities and make it easy for teens and teachers to access the best of what you have available for STEM-related learning.
- Out-of-school-time programs: If you put your mind to it, you'll discover numerous possible STEM connections for the out-of-school-time programming you provide. Gaming sessions, candy sushi projects, digital content creation—all can have a relationship to STEM. Every time you develop a new program, think about the potential STEM associations and make sure to highlight those when talking with teachers, administrators, and parents.

Examples of Successful STEM Programming

In order to give you an idea about what a solid STEM-oriented program looks like, we have included links to a number of successful initiatives. Remember: many programs take months to plan and implement. Expect to put a lot of time into STEM programming, but don't set any unrealistically high standards. Measure outcomes instead of outputs by collecting qualitative information from the participants. Encourage participants to stay in touch. When it comes to STEM education, the results of our efforts often manifest themselves well after the program has ended.

- STEM Teen Read: The public libraries in Illinois's DeKalb County are partnering with Northern Illinois University's STEM Outreach Department to provide year-round teen programs. Throughout the year, teens read selected science fiction books, participate online, and then meet up virtually or live for free discussions and Q&A sessions with experts who explain the science behind the fiction. While reading each book, teens can join virtual chats, watch related videos, share fan fiction, and connect with other teens on the program's website. The most

successful program to date was an entire day of programming with Cory Doctorow in attendance.

- In "Beyond LEGOS: Coding for Kids", Gretchen Caserotti writes about her library's successful kid's coding classes and provides an amazing annotated list of resources. She says, "don't let the fact that you don't know how to write code stop you from helping the kids at your library learn."
- Westport Public Library: Check out this great site to see how one public library has embraced STEM through the maker movement. (For more about Makerspaces, read below.)
- Thanks to a unique partnership between the Buffalo Museum of Science (BMS) and the Buffalo & Erie County Public Library System (B&ECPLS), youngsters in the City of Buffalo have the opportunity to enhance their science and literacy skills through Branched Out, a FREE fun-filled series of programs offered in select city library branches. The Branched Out program gives children the chance to learn through "doing, talking, reading, and writing about science." The Museum of Science provides the instructional staff and the science activities.
- Johnston Public Library (Iowa): "Small to medium-sized libraries like Johnston Public Library don't always have a lot of resources. However, we need to make the time and keep a connection to STEM learning for the sake of our community and its youth. In addition, STEM has been the most successful type of programming we have offered, and we're committed to implementing it throughout the year in various ways."... Read more about the project they implemented here.
- Don't overlook ALA's science related exhibits: http://www.ala.org/programming/exhibitions. They're great to use as a springboard for programming and give a centerpiece exhibit. Spokane Public Library is hosting the ALA Science and Technology exhibit and successfully planned programming to tailor to the exhibit: http://www.spokesman.com/stories/2012/sep/27/engineered-to-educate/.
- Similarly, two years ago, the North Olympic Library System's Port Angeles Main Library planned a series of programs centered on an ALA Visions of the Universe Exhibit. Events included scavenger hunts, class visits, a celebration with keynote speakers, the high school choir, storytelling about space, and crafts, in addition to the use of a portable planetarium. The exhibit led to other collaborations with the high school, the launch of a Saturday Science program for elementary school kids and retooling programming to routinely put science-related programming into the schedule. The library was named a Science Education Advocate by the Washington State LASER committee (which comes with a $5000 prize) for its work on the Visions project and integrating science into its programming.

Need even more ideas and resources? Check out YALSA's STEM Resources Wiki for inspiration as well. And remember to help build the wiki by adding your great ideas it after your program!

STEM and Makerspaces

The past few years have seen increased interest in making and makers. A maker is someone who makes something -- from food to robots, wooden furniture to microcontroller-driven art installations. Makers are typically driven by their curiosity for learning and creating new things, as well as by an interest in sharing their work and processes with others. Makerspaces are flexible spaces that allow people to come together to explore their interests through hands-on activities. For STEM, makerspaces have the potential to demystify science, math, technology, and engineering; and encourage women and underrepresented minorities to seek careers in those fields.

So how do libraries fit into this? Fayetteville Free Library Executive Director Susan Considine captured it when she said, “Libraries exist to provide access to opportunities for people to come together to learn, discuss, discover, test, create. Transformation happens when people have free access to powerful information, and new and advanced technology."

If we believe that libraries are centers for knowledge exchange, then Makerspaces are a perfect fit. Libraries are a place for social transformation. They’re a place that you can go to get computer access, or access to technology that you can’t get anywhere else, and access to people. The Makerspace is a way to create a center for knowledge exchange, where you can offer Intro to Computer Programming, or Digital Fabrication — and help build skills that are important in the STEM fields. And what’s the best thing for your community? It’s all free!

So read on to learn more and find out how you can get started.

Articles

Part 1: Space for Creation, Not Just Consumption - http://www.thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-1-space-for-creation-not-just-consumption/

Part 2: Espress Yourself http://www.thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-2-espress-yourself/

Part 3: A Fabulous Home for Cocreation http://www.thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-3-a-fabulous-home-for-cocreation/

Blog about Makerspaces in schools: http://www.edutopia.org/blog/stem-engagement-maker-movement-annmarie-thomas

Makerspace Resources

Makerspace Directory: Find a makerspace near you at this comprehensive site.

Public Library Association (PLA Webinar): Available at the ALA Store, the PLA webinar gives you the scoop on how to create your own space.

Maker Camp: A virtual DIY camp for teens with a focus on creating, building, and discovering. It's free and open to all on Google+. They have 30 days of awesome projects in the summer that could make your planning a cinch!

Maker Faire Homepage: Links to Faires all over the world.

Make Projects site: filled with every resource you could possibly need regarding makerspaces.

Candice Mack has a great YALSAblog post on Makerspaces at http://yalsa.ala.org/blog/2012/10/25/connect-create-collaborate-sparking-the-maker-movement-at-your-library/

Examples of Library Makerspaces

- The Skokie Illinois Public Library offers a Digital Media Lab where library users are able to "creatively express themselves through digital videos, music, photography, websites, graphic design, podcasts, presentations and other forms of digital media".
- The Barrington Area Library in Illinois also has a Media Lab on a smaller scale--proof that you don't have to have a large space to offer amazing digital tools to your patrons!
- Fayetteville Free Library FabLab is renovating a wing of their building to provide a permanent location for their Fab Lab. In the meantime, many "making" technologies are accessible in their Creation Lab, a smaller scale digital media lab.
- Look for possible funding through grants with IMLS which funds learning labs across the country. http://www.imls.gov/about/learning_labs.aspx
-

Sample STEM Programs

Need some help getting started? The toolkit provides several detailed sample programs ready to implement. They are sure to get you thinking about what else you could do with teens and STEM at your library! The following is just an overview of each program. Be sure to check out Appendix C for the complete program lesson plans.

23 More Ideas to Get You Excited About STEM

1. Offer a class on basic computer programming using Scratch. "Scratch is a graphical programming language for kids that was designed at the MIT Media Lab. To write a program in Scratch, you connect colored code blocks together." -- Mark Frauenfelder of BoingBoing.com. He recommends the book *Super Scratch Programming Adventure* (ISBN 978-1593274092) as a training tool.
2. Partner with local restaurants, grocery stores, or a dietitian for a Cooking Chemistry program.

3. Invite local adults in STEM fields such as scientist and engineering for a STEM Career Smackdown. Ask them each to share who they are, what they do at work, what they need to learn and do to become a _____, etc.
4. Pair local adult geeks with budding teen geeks, speed dating style, to discuss interests, career paths, and education planning for life in the STEM fields. STEM Career Craziness!
5. Bring out your devices, encourage teens to bring theirs, and invite local electronics stores to show off the latest gadgets at a Technology Petting Zoo.
6. Invite local robotics or LEGO teams to demonstrate and share their experiences. Girl Scouts offer a FIRST LEGO League--partner with your local council for an after-school program.
7. Invite local STEM experts or organizations to talk to kids about their STEM research projects and programs. Showcase your STEM resources, collection, databases, etc. too.
8. Host a Rubik's Cube competition. Show Speed Cubing video clips from Rubik's TV to inspire the participants.
9. Invite a representative from the local agricultural extension to tour the library grounds or surrounding area for plant identification and wildlife observation. No nature nearby? Ask him or her to bring in specimen for show and tell--invite the participants to do the same.
10. Use the library computers and equipment to showcase digital media--make images, movies, and interactive media to compile in a digital zine.
11. Make booktrailers with Flip cameras, Animotos, Blabbers, or other technology.
12. Celebrate digital media and creativity with a *Really* Short film Fest. Have kids share their digital media creations followed by snacks. (Lay out clear guidelines and it may be necessary to preview them beforehand.)
13. Host an online book club or literature circles for teens on wikispaces.
14. Bring in a science show performer. Dave Maiullo from Rutgers University is great.
15. Have a TED Talk or Battledeck style series of local STEM peeps giving 10-minute talks about an interesting STEM story or narrate STEM-themed slides.
16. Offer teens the chance to help create and/or maintain or revamp your library web site or blog.
17. Start a coding club or host a LAN party.
18. Have an Intro to Hackasaurus class. This site has extensive resources in a kit format complete with everything someone needs to host an event.
19. Host a LEGO creation party and display your teens' works of LEGO art.
20. Host a C*areers in Medicine* night with local colleges, universities, or nursing degree programs.
21. Start a *Geek a Senior for Community Service* program by pairing your teen volunteers with senior citizens who want to learn how to use email, etc.

22. Create Rube Goldberg machines. This seven-year-old predicted the success/ failure rate of his machine, documented the process of correcting the failures, and made a YouTube video of the process.
23. There are lots more suggestions at "Get Excited About STEM!", a guest post by Cindy Welch of YALSA's Editorial Advisory Board, has some quick tips for getting started with STEM programming at your library. This article can be found on the Online Companion to the Official Journal of the Young Adult Library Association.
24. How to Smile provides a wealth of ideas for science and math activities and won AASL's "Best Website of 2012." You have to register to access all of their resources, but it is free!

Stealth STEM Programming

While it's great to have consistent, well-attended programs for teens, this is not always realistic. If you are the only librarian or library worker serving teens, or if you have other duties as well, it can be hard to carve out time dedicated to programming. Not only are library professionals busy, but so are teens. Between afterschool activities, jobs, and homework, choosing a time that works for your teens can be almost impossible. For those times when there just isn't enough time, why not try some stealth programming? What is stealth programming? It's a great way to get teens involved in the library asynchronously. It's a great way to promote the resources you have available. It's a great way to keep those teens busy while they are hanging out. Stealth programming is something that is set out for teens to do whenever they happen to be in the library. It could be a craft, an activity, a puzzle, a trivia question, or anything you can think of that teens can do on their own. It's also a perfect way to use those makerspaces. There are a lot of things that teens can do in makerspaces with limited to no supervision, such as creating videos, podcasts, or altered photos. You can offer prizes for participation or correct answers. Prizes do not need to be expensive or elaborate. Small candy bars, decals for cell phones and mp3 players, cell phone charms, or cheap ear buds will all appeal to teens.

Stealth STEM Programming Ideas

Check out the following ideas to get started on implementing stealth programming at your library. Need a more complete idea and lesson plan? Then check out Appendix D for a program called ""Today at the Library…" Fake Photo Contest.

1. Set out an assortment of Rubik's Cubes, solution guides, and kitchen timers to encourage spontaneous competitions.
2. Set up a space to display local natural history specimens such as plants, fossils, etc. Ask teens to contribute samples and provide references to assist with identification. Provide a map to mark the source of the specimen. For inspiration, check out the photos of the Mount Pleasant Public Library's Natureology Programs in Mount Pleasant PA.

3. Other ideas can be found on Pinterest and Passive Programming Ideas by Kelly Jensen & Jackie Parker from American Library Association, June 2012
4. Create a scavenger hunt that highlights library technology.
5. Set out old electronic parts to create jewelry or robot sculptures. Include a few technology craft books to inspire them.
6. The Texas State Library suggests creating a "Teen Review Notebook" for teens to leave reviews of the books they've read. This could also be a document on the teen computers or a blog.
7. Set up a webcam for teens to create video reviews that can be displayed on monitors in library, the library blog, or library website. This could be a great activity for a makerspace.
8. Hold a photo contest for teens. Have them take pictures of themselves or friends in the library or reading their favorite books. http://bighugelabs.com has some great tools for adding frames and other effects to photos.
9. Is there a room or area of the library that is not always in use? Set up a TV and video games for teens to come in and play after school.
10. During Teen Tech Week™, have a daily Tech Trivia Question and provide prizes for each teen who correctly answers.

FREE Computer Programs for Stealth (and other) Programming

Gimp: You don't have to spend a lot of money for Adobe Photoshop. Gimp offers the same features for free.

SumoPaint: This image editor stores your projects in the cloud and allows you to share them with other artists. Projects can be edited from any computer with internet and there is no need to store projects on the computer.

Windows Movie Maker: Newer versions of Windows come with Movie Maker already installed. If it is not already on the computer, you can download it for free.

Video Spin: Another free video editor, Video Spin does not have many advanced features, but makes it easy to quickly edit and create mashup videos.

Lightworks: The free version of Lightworks video editor has a lot of great features, with the option to upgrade to a paid version with even more capabilities.

WeVideo: This cloud based video editor requires nothing more than setting up an account. Users can access their projects from any internet connection and patrons do not need to store projects on library drives.

Scratch: This is a free download available from MIT that teaches patrons to code using "code blocks" similar to Legos.

Puzzle Maker: This free site allows you to create crosswords, word searches, mazes, and other puzzles for your patrons to complete.

Portable Apps: This site provides free software that installs on any portable storage device (e.g. USB drive). Nothing installs on the computer itself. There are a variety of programs for editing video, photos, and sound; games, screen capture tools, and more.

Wrapping It Up

When library professionals program for STEM, they must think like scientists:

- Hypothesis: This is the plan made for the STEM program.
- Experiment: This is what happens when the STEM program is implemented.
- Results: This is what library professionals witness at the events as well as the feedback they receive from participants & parents or interested adults.
- Conclusion: This is where library professionals decide what, if anything, needs adjustment for future STEM programs.

We library professionals are not so different from scientists. When we program we use trials (experiments) & evaluation. The most important thing to remember is DON'T GIVE UP! Get feedback from participants as to how to improve the program. It might be as simple as rescheduling events, or the entire program might need overhauling. Whatever the changes needed, STEM education is worth doing.

Keep in mind that the library offers a unique opportunity to present STEM projects outside of the traditional science classroom experience. Library professionals can help excite students about the subjects and skills they might need for future careers. STEM education based on the scientific method can also reinforce the idea that not everything in life has to go as planned or turn out right the first time. Students will need to learn to plan, experiment, and evaluate as they make all their life choices. STEM education, particularly in the vibrant library setting, can help provide students with skills they will use all their lives.

You don't have to reinvent the wheel; remember to check out existing sites for resources like YALSA's STEM Resources Wiki.

Appendix A
Sample STEM Program Action Plan

The following is an example of a completed sample action plan for a Teen Tech Week™ training held by the Idaho Commission for Libraries.

STEM PROGRAM Action Plan

Identified Need: _____

_____

Goals: _____

_____

Partners: _____

Target Audience: _____ **Program Dates:** _____

Expected Attendance: _____

Program Description:

_____

_____

_____

_____

Marketing Message:

_____

_____

Technology and Materials Needed:

_____

_____

Project Steps:

What:	Where:	When:	Responsibility:	Est. Hours/Cost:

Marketing:

What:	Where:	When:	Responsibility:	Est. Hours/Cost:

Evaluation:

What:	Where:	When:	Responsibility:	Est. Hours/Cost:

Other:

What:	Where:	When:	Responsibility:	Est. Hours/Cost:

Appendix B
Teen Program Evaluation Example 1

Sample Teen Survey

Age:

Do you have a library card?

What was the last book you read and enjoyed?

How did you hear about the program?

The length of this program was:

Too long Too short Just right

What was your favorite part of the program?

What suggestions do you have for improving the program?

Would you attend a future program?

Would you recommend a friend attend a future program?

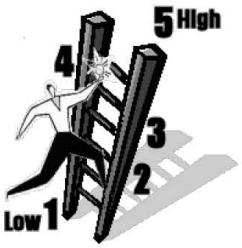
What other topics would you like to see included in our programs?

Do you follow us on Facebook?

If not, why?

Any additional comments?

Teen Program Evaluation Example 2



Teen Program Evaluation Tool

Program Name_____

Date/Time: _____

Total Number of Attendees: _____

Use this tool to poll attendees before and after your program. You just need to add in your specific areas of focus in the parentheses below. These will be directly related to the desired outcomes of your program. You could always add another question to this, but try to keep it short and easy to administer to teens!

You can poll them in a group or ask the questions individually. If you poll them as a group, make sure to capture the number of each response in order to collect accurate data. You can then total the responses and divide by the number of participants to get an average "score" for each area and see growth from before to after (we hope!) See the sample evaluation provided for an example of what this might look like.

Two thumbs up is the highest response or a 5, one thumbs-up a 4, a side-ways thumb is right in the middle or a 3, one thumbs down a 2, and two thumbs down is the lowest score or a 1.

Use the back of this sheet to record anecdotal data. Things you hear the teens say that capture the success of the program, or help you see areas you can improve are all valuable. Make notes on things you see the teens doing as well. These all add to the picture of your program's impact on the teens.

BEFORE the program (1 is low and 5 is high)	AFTER the program (1 is low and 5 is high)
1. My overall understanding of (topic here) (low) 1 - 2 - 3 - 4 - 5 (high) # of each	1. My overall understanding of (topic here) (low) 1 - 2 - 3 - 4 - 5 (high) # of each
2. How confident are you with (tools/software here) (low) 1 - 2 - 3 - 4 - 5 (high) # of each	2. How confident are you with (tools/software here) (low) 1 - 2 - 3 - 4 - 5 (high) # of each
3. My ability to build/make/create (project/product here) (low) 1 - 2 - 3 - 4 - 5 (high) # of each	3. My ability to build/make/create (project/product here) (low) 1 - 2 - 3 - 4 - 5 (high) # of each
4. My interest in STEAM topics or areas: (low) 1 - 2 - 3 - 4 - 5 (high) # of each	4. My interest in STEAM topics or areas: (low) 1 - 2 - 3 - 4 - 5 (high) # of each

5. How likely are you to come to another program similar to this one?
(low) 1 - 2 - 3 - 4 - 5 (high)
# of each

Anecdotal Data
(Things I Heard, Things I Saw…)

Appendix C
Sample Program Lesson Plans

Roller Coaster Ski Jumps

Time: 1 hour

Lesson Objectives:

- Students will experiment with the forces of motion by rolling a marble on a curved track.
- Students will explore the variables of angle, distance, and different building materials.
- Students will gain practical knowledge about gravity, momentum, speed, and angles.

Materials:

- Foam pipe insulations (cut in half lengthwise), 1 pipe/2 halves per group
- Marbles, 5 per group
- Rolls of masking tape, 1 per group
- Containers, coffee-can like, 1 per group
- Tape measures, 1 per group

Set-up:

The students will work in small groups. Each group will get 2 pipe halves, 5 marbles, a roll of masking tape, one container for the marble to land in, and one tape measure. Students will use the tape to attach the pipe halves to things like tables, chairs, walls, etc. to hold up their roller coaster ski jump. Try to give each group enough room to set up their track. You might want to have a few other items such as boxes, baskets, books, etc. for the students to use as additional building material.

Lesson plan:

1. Introduction (5 minutes)
    a. Explain that today the students will be working in teams on an engineering challenge.
    b. Ask the students: “What do you think engineers do?”
    i. They may say that engineers build things or design things like structures and cars.
    ii. Explain, if they haven’t already said, that engineers use technology, math, and science to solve a problem to create a design.

2. Experiment Instructions (5 minutes)

a. Explain that the engineering challenge is this, the students are to design a combo roller coaster ski jump that must have these three components:

i. A loop de loop, where the marble goes in a circle around the pipe half

ii. A hill, where the marble goes up and then down again in the pipe half

iii. A jump, where the marble goes up into the air and flies through the air and lands in the container and stays in the container.

3. Experiment First Execution (20 minutes)

a. Have each group get their materials and start building.

b. About 10 minutes in to the building, go around and see how the students are doing.

c. If necessary, stop the building and offer some tips and queries:

i. If the marble is going too slow, what about starting it off higher or lower?

ii. If the marble is going too short off the jump, what about lowering or raising the jump?

iii. If the marble is not getting around the whole loop, what about making the loop bigger or smaller?

4. Experiment First Demonstration (10 minutes)

a. Have each group take a turn and see how many of the five marbles they can get to go successfully around the loop, over the hill, and jump off into the container.

i. If you wish, have the students measure how far from the end of their rollercoaster ski jump to their container their marbles jumped.

b. After each group demonstrates, ask the students why they thought their rollercoaster ski jump did well or poorly.

c. Ask why they thought other groups did well or poorly.

d. If they haven't already, bring these points to their attention:

i. When the marble leaps off the end of the track, it keeps going and flies through the air. How far it flies depends on how fast the marble goes at take-off and which way it points during take-off.

ii. To get the marble to travel down the slope and go faster, you need to have a steep track and a high starting point.

iii. The faster the marble travels around the loop, the better chance it has of making it all the way around.

iv. A long, straight, steep run-up to the loop will give the marble maximum

speed before starting the loop.

5. Experiment Second Execution (10 minutes)

a. Give the students another chance to revise their design.

6. Experiment Second Demonstration (10 minutes)

a. Have each group take a turn and see how many of the five marbles they can get to go successfully around the loop, over the hill, and jump off into the container.

b. After each group demonstrates, ask the students why they thought their roller coaster ski jump did well or poorly.

c. Ask why they thought other groups did well or poorly.

Extending the Program: Roller Coaster Ski Jumps

Discovery School DVDs to View:

- Roller Coasters Maximum Thrills, Minimum Danger, Discovery Communications, c2004.
- Roller Coaster Physics, Discovery Communications, c2004

Books:

- Using Math to Design a Roller Coaster by Hilary Koll, Steve Mills, & Korey T. Kiepert, Gareth Stevens Publishing, c2007.
- Marvelous Machinery: Rides at Work by Nathan Lepora, Gareth Stevens Publishing, c2008.

Discuss how friction is relevant to the experiment:

- Place pieces of different textured materials, such as felt or sandpaper, in your track.
- Attempt to reduce friction by adding an oily material in your track.
- Observe the results and discuss.

Magnets are often used in roller coaster breaking systems. Explore experiments using magnets to slow your coaster.

Discuss G Forces, both positive and negative:

- Explore experiments to demonstrate these concepts.

Discuss human tolerances for G forces.

- Design a coaster car that can carry a human representation - such as a figure made out of clay.
- What kind of safety features would the coaster car require?
- What kind of safety features would the coaster require?

Having an Electric Personality

Time: 1 hour

Lesson Objectives:

- Students will participate in an interactive activity where they will be challenged to create a circuit.
- Students will explore electricity by creating a simple circuit.
- Students will experiment with conductors and insulators by determining which materials allow electricity to flow and which do not.

Materials:

- D batteries, 1 per group
- Lights cut from a string of holiday lights, 1 per group. Light should have about a half inch of cord on each side of it and the wires inside should be exposed about a quarter inch worth.
- Aluminum foil cut, cut into 5 six inch squares, 1 per group
- Paper clips, 1 per group
- Plastic covered paper clips, 1 per group
- Pennies, 1 per group
- Pipe cleaners, 1 per group
- Bolts, 1 per group
- Erasers, 1 per group
- Plastic buttons, 1 per group
- Spring-action wooden clothes pins, 1 per group
- Drinking straws, 1 per group
- Pencils
- Scratch paper

Set-up:

The students will work in small groups. You can have the items set out on the tables the students will work at or you can have them gather them themselves when it is time.

Lesson plan:

1. Introduction (5 minutes)

a. Ask the students if they have used electricity today. What did they use it for?

b. Ask how they think electricity works? Why does pushing a button or flipping a switch make something turn on? Where does electricity come from? How does it get where it is going? The students may say something about wires or batteries.

2. Electricity Explanation (5 minutes)

a. Explain that electricity follows a very specific path called a circuit. The electrical current starts at a source, like a battery. It is carried along a conductor, a material that allows electricity to flow easily, and it performs a use, such as lighting a light bulb. Materials that do not allow electricity to flow easily are called insulators.

3. Experiment Instructions (30+ minutes)

a. Tell the students that each group will get a battery, a light, and a bunch of other materials. Their job is to test each material to see if it is a conductor or an insulator by seeing if they can make a circuit between the battery and the light and make the light turn on.

b. As the work, have them write down what materials are conductors and what materials are insulators.

c. Let them get started.

d. As they work, walk around and see if they need any assistance, since certain items will not be long enough to complete the circuit, the students might not realize the trick is to combine conductors, such as the aluminum foil and the penny.

4. Compare results (10 minutes)

a. After everyone has had a chance to test every material, ask them about their results.

b. What materials were conductors? What materials were insulators? Were any materials able to be both? (The wood of the clothespin is an insulator while the metal spring is a conductor. The metal of the pipe cleaner is a conductor while the fluff is an insulator. The rubber cover of the paper clip is an insulator while the metal is a conductor.)

c. What was similar about some of the conductors? (They are all metal.) What was similar about some of the insulators? (They are all rubbery.)

5. Extra time experiment (10 minutes)

a. Challenge the students to try and make the longest circuit they can. Have them team up with other groups if they wish.

Extension Activities: Having an Electric Personality

Sew a Simple Circuit into Felt to Create a Snap Bracelet:

- Complete instructions can be found at atx diy

Float Your Boat

Time: 1 hour

Lesson Objectives:

- Students will participate in an interactive activity where they will work in groups and be challenged to design an aluminum foil boat that can hold the most pennies.
- Students will learn what buoyancy is.
- Students will learn how to calculate volume.

Materials:

- Pennies, 100 per group
- Aluminum foil, cut in 6 inch squares, 6 per group
- Bowls big enough to hold the foil laid flat, 1 for each group
- Towels (optional)

Set-up:

The students will work in small groups. Each group will receive 100 pennies, 6 aluminum foil squares, and one bowl filled halfway with water.

Lesson plan:

1. Introduction (10 minutes)

    a. Explain that today the students will be learning about why things float by making aluminum foil boats that can carry a load of pennies.

    b. Explain that buoyancy is the ability of an object to float on a liquid. When a boat floats, it settles into the water, pushing the water aside to make room for itself. But it's a two-way pushing match- the water pushes back on the bottom and sides of the boat. This force, called buoyancy, holds the boat up. The more water a boat pushes aside, the more force there will be pushing back on the boat and supporting it. This is why a boat's size and shape make such a difference in how much of a load it can carry without sinking.

    c. Divide the students into groups and have them get their materials.

2. Experiment (15 minutes)

    a. Build

    i. Tell them to design and build their boat by bending the foil.

    ii. After they have designed their boat, have them measure the longest side of the bottom, the shortest side of the bottom, and the highest side of the side of the boat and write down the data.

    iii. You can have them multiply longest side and the shortest side together to get the total area of the bottom of the boat. Explain that "area" is how much space a flat object takes up.

    iv. You can have them multiply all three sides together to get the total volume. Explain that "volume" is the amount of space that a three-dimensional object takes up.

    b. Make predictions

    i. Have the students predict how many pennies they think their boat will hold before it sinks.

c. Test the design

i. Have the students put their boats in the bowls of water. Tell them to gently place one penny at a time in their boats. Warn them if they throw pennies into their boats they will sink them too quickly. Keep going until the boat does sink, then count how many pennies they were able to put in the boats.

3. Discuss what happened (10 minutes)

a. Bring the group together. Have students put their boats in sequence from least pennies held to most.

b. Compare the groups' results. Ask why they think their boats did well or poorly. If necessary, point out the differences in sizes of the boats and how many pennies the biggest bottom and smallest bottom boats held.

c. Repeat the experiment and try to improve the results by using what they have learned.

<u>Extending the Program: Float Your Boat</u>

- Have participants experiment with different materials and shapes to see which items float the best.
- Using a variety of materials (foil, paper, cardboard, foam, wooden sticks, etc), have participants build boats based on different criteria (biggest, smallest, lightest, fastest).

Appendix D
Stealth Programming Lesson Plan

"Today at the Library…" Fake Photo Contest

Program Source: Adapted from an idea in YALSA's 2007 Teen Read Week theme, "LOL @ Your Library"

Time: Several weeks

Lesson Objectives:

- Participants will participate in a library activity when it is convenient for them.
- Participants will demonstrate knowledge of photo editing software.
- Participants will demonstrate the ability to take a well-composed picture.

Materials:

- Digital camera (participants may use their own camera or phone, but the library should have at least one on hand for participants who do not have one.)
- Photo editing software (such as Photoshop, Google's Picasa, Photoscape, Gimp, Paint.net, etc.).
- SD card readers (in order to transfer photos to the computer)
- Ballots for voting
- Instruction sheets for participants.
- Prizes for winners such as cash, gift certificates to camera stores, certificate for classes at camera shop or art classes, small digital or video camera, SD cards, photography book. You may want to contact local camera stores for possible prize donations.

Set-up:

2+ months prior: Get permission from library director, schedule program on library calendar and begin contacting local vendors for prize donations.

1 month prior: Post flyers in library and, if possible, in local camera shops, schools, etc. Submit information to small newspapers, community calendars, etc. Decide on contest categories (best Photoshop skills, funniest, most shocking, best caption, best overall) and prizes.

The following is a sample of what might appear on your flyers and marketing materials:

What really goes on at the library when no one is looking? Exactly what was left in the book drop? What landed on the roof of the library? Who's that coming through the front entrance? Use your imagination and your camera to show us what really happened "Today at the Library"! Were penguins browsing the global warming books? Did the Star Trek Enterprise try to land on the roof? Was Michigan's coach caught checking out Football for Dummies? You shoot a photo; edit it to show the best, funniest, most

shocking things that happened today at the library! Submit it for the contest, we'll display it in the library and patrons can pick the winners.

2 weeks prior: Promote program to teens and online through blog, Facebook, Twitter, and other online outlets.

Display a sample photo in teen area to promote contest. Create ballots for patron voting and rules for entry. Create sample photo to display in teen area.

Lesson plan:

1. Introduction

    a. Have instruction sheets in the teen area, reference desks, and circulation desks. The instructions should be explicit, so that teens understand exactly what is expected.

    b. Make sure that teens who do not have their own camera know whom in the library to ask about using the library's camera.

2. Taking Photos

    a. Teens will take a photo of the library (any angle, inside or out) and modify it using photo editing software.

    b. Entries should reflect the theme of "Today at the Library…" and can include a short funny caption for the photo.

    c. Encourage teens to be super-creative and all the various spaces in the library, the book drop, the children's area, local history collection, etc.

3. Displaying and Voting for Photos

    a. When possible, display entries as soon as they are received.

    b. Set ballots out during the chosen voting period. You may want to allow patrons to vote throughout the contest or to hold all voting until the entries are all in so that early entries do not have an advantage.

    c. Keep supply of ballots updated and possibly post entries on blog.

4. Announcing the Winners

    a. Set a date to announce contest winners either during a teen program, or through media outlets such as the blog, website, or Facebook.

    b. Contact the winners to pick up their prizes.

Appendix E

Selected Additional YALSA Resources

- Teen Tech Week™ is celebrated each year the second week of March, www.ala.org/yalsa/teentechweek
- YALSA offers monthly webinars on a range of topics, including technology and programming. Learn more at www.ala.org/yalsa/webinars. All archived webinars are free to YALSA members.
- Lillian, Jenine. *Cool Teen Programs for Under $100*. (Chicago: YALSA) 2009. www.alastore.ala.org/detail.aspx?ID=2757
- YALSAblog has new content daily, including posts on topics such as library programming for teens: http://yalsa.ala.org/blog/
- Additional toolkits and pamphlets can be found at www.ala.org/yalsa/handouts, including "30 Positive Uses of Social Networking" and the "Librarians' Social Networking Toolkit."
- To find and share programming and other ideas relating to library services for an with teens, subscribe to the YA-YAAC email listserv, http://lists.ala.org/sympa/info/ya-yaac
- "Strengthening Teen Services through Technology" curriculum kit, forthcoming spring 2013, www.ala.org/yalsa/young-adults-deserve-best