STEAM* PROGRAMMING TOOLKIT

(*Science, Technology, Engineering, Arts & Math)

Created by: STEM Resources Task Force
2/20/2013, and updated 12/14/16

STEAM Programming Toolkit

List of Contents

Forward

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.

Access the online version of this toolkit at www.ala.org/yalsa/professionaltools.

About YALSA
The mission of YALSA is to support library staff in alleviating the challenges teens face, and in putting all teens – especially those with the greatest needs – on the path to successful and fulfilling lives. YALSA is a subspecialty of the American Library Association, the world's largest 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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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, Arts, and Mathematics (STEAM) into programs and services.

What is STEAM?

STEAM stands for "Science, Technology, Engineering, Arts and Math." The acronym is used to refer to those areas of study which encompass a wide range of sciences and the arts. The last decade has seen an increase in STEAM 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 Program for International Student Assessment (PISA) ranked the scientific comprehension of American students 21st out of 30 developed nations.

STEAM 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 STEAM 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 STEAM, including the American Library Association (ALA).

This focus continued 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 STEAM 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 2012, American teens ranked 27th in science and 35th 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 STEAM 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 STEAM, but may not yet be seeking out the available grant funding to support it. Yet libraries are in a good position to help young adults gain key skills in STEAM areas. By providing fun programs that incorporate STEAM 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 STEAM 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 STEAM 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 STEAM

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

- [The Condition of STEM 2016](#) reviews the 2016 graduating class in STEM related subjects to show student interest STEM fields and their skill level in these areas of study.

- The National Science Foundation brings us [STEM Education Data](#). Explore the data through interactive charts and maps that focus on different topics across all levels of education and the STEM workforce.

- [Federal Science, Technology, Engineering, and Mathematics (STEM) Education](#): A 5-year strategic plan of STEM education from the White House.

- ["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:
    o 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?
    o What strategy, with several concrete steps, could be used to implement each of those actions?

- [STEAM 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 STEAM 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 STEAM fields." – from [Defining Youth Outcomes for STEM Learning in Afterschool.](#)

- [STEM Reports](#) compiles cutting-edge research and articles on STEAM 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 recent 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 STEAM into action.

Getting Started

You realized there is a need in your community for STEAM 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 STEAM 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 every aspect of your program – from identifying desired goals and outcomes 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 is 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! You should also check out the determining and measuring outcomes section of YALSA's wiki.

Creating an Action Plan

Using an action plan to help plan and implement your program 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 audience and need and use these to create program goals is a good place to start your planning. Do some community assessment to find out what specific needs teens in your community have relating to STEAM skill building and hone in on the audience with the most need. This YALSAblog post about equity in STEM programming may be of interest as you work through this stage of your planning, as may these wiki resources about community assessments.

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 the next section for information on partnerships.) Furthermore, not all STEAM-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 STEAM education reform efforts.

Ideas for Any Size Budget
Depending on your program goals, 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 STEAM skills - sometimes without even knowing it!

So, you have a bit of money to spend? Great! Check out the Roller Coaster Ski Jumps in Appendix C. It won't blow your budget, takes about an hour, and also makes use of commonly found recycled objects. Another affordable resource are the STEM curriculum guides from 4-H. If you have a larger budget available, consider a multiple day project to engage your tweens and teens during a spring or summer break, or a recurring program that takes place throughout the school year. This provides you with the opportunity to delve deeper into a subject and have a final 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 one of the many kits from PCS Edventures! They have kits for every age and for every STEAM area you could ask for so have fun exploring their site.

As you can see, whatever your goals or 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

Partnering with another library, school, or community organization can lead to better outcomes for the teens in your community, as well as offer benefits to you and your library. By connecting with individuals or groups in the community, you can ensure that you're bringing together those with the most passion and expertise in serving teens around STEAM issues. These partnerships can also help ensure that you're able to reach all the teens in your community who have the greatest need for this type of programming. Partnering also 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 or collaborations.

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

- Identify what partnerships your library already has
- Talk to your supervisor to find out what sort of guidelines or policies the library has relating to engaging in partnerships. Make sure you read and comply with them.
- Develop a clear understanding of the needs of your community's teens and the goals you've set for serving them. Think through how a partner can help your library meet these needs and achieve these goals.
- Identify what knowledge, resources, services, expertise, support, etc. you are seeking from a partner
- Make a list of assets your library has that you can bring to a partnership. Use this worksheet from YALSA
- Write up a paragraph for potential partners that articulates the benefits for them if they partner with the library. Include past examples of   successful partnerships.
- Do some research to find out who potential partners may be in your community, and identify which have the most potential. Use the Map My Community tool to find out what organizations in your community might be good prospects. Look for attributes like:
  - mission alignment: ensure that their area of focus closely aligns with what you want to achieve through the library

- - - capacity in terms of staff, resources, space, etc.
  - experience: prior successful partnerships, staff with relevant expertise
  - reach: ability to connect and engage with the teen audience you're trying to work with
- Determine how best to approach the potential partner. For example, do you or one of your co-workers know someone who could introduce you to a contact at the organization?
- Prepare a well-curated packet of information to share with the partner, including basic information about the library, the paragraph you wrote describing the benefits of partnership, the list of assets you developed that the library can bring to the partnership, press releases and photos of successful programs, contact information for you and key library personnel, and whatever else you determine is essential at this early stage.

Ideas for Local Partnerships

You don't have to live in a big city to find suitable partners. The possibilities for local STEAM related partner organizations are limitless. A great starting point is the Map My Community Tool. Just type your zip code into this free tool, and you can find out what other youth-serving organizations are in your community. Besides working together with youth-focused organizations, also consider these options:

- The Connectory maintains a list of STEM focused programs available across the U.S. You can search their list to see what's in your state or area.
- 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 STEAM 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 STEAM activities. Find out of there are relevant afterschool clubs at the schools, including ones that are career, science or arts oriented. Don't forget your community colleges, colleges, and state universities. Explore how faculty or students could support your library's STEAM efforts, such as by starting 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 STEAM 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 afterschool program providers such as 4-H Clubs, Boys & Girls Clubs, the Y, and more. The National Afterschool Association has affiliates in many states. Check their website to see if yours does. 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, art or children's museum in your area. Take advantage of the work already being done by these STEAM 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. Contact them to find out what they're already doing in the STEAM area and whether or not they'd be interested in sharing their resources or collaborating on a project.

- Is there a state or federal research facility in your area? Think about the businesses in your community that fall under the STEAM 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.
- Think about what local businesses work on STEAM related products or services and reach out to them. You might start at the local Chamber of Commerce to identify potential businesses.
- Find out if any library advocates or patrons work in a STEM or arts field and see if they'd be willing to support the library's STEAM programming in some way.
- You may have astronomy, biology, computers, even science fiction clubs already exploring STEAM topics through the local park district or school. Investigate what they're doing and whether or not they could be potential partners.

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

National Organizations Emphasizing STEAM
Looking beyond your own backyard, there are a number of national organizations that can help you:
- [American Society of Mechanical Engineers](#)
- [I Art Libraries](#) provides resources specifically for libraries to help plan and implement services and programs to help patrons create and connect with others who are interested in creating and art
- [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 sySTEAM, astronaut health, the Moon, Mars, Jupiter, and space exploration.
- The [National AfterSchool Association](#) supports "increasing high quality science, technology, engineering, and mathematics (STEAM) learning opportunities for children and youth during out-of-school hours." Online resources available at their *STEAM - The Year of Science* website.
- [National Art Education Association](#) provides standards, continuing education opportunities and more around STEAM education
- The [National Girls Collaborative Project](#) brings together organizations throughout the U.S. that are committed to informing and motivating girls to pursue careers in science, technology, engineering, and mathematics (STEAM).
- [Remake Learning](#): STEAM Competencies from Remake Learning
  - http://remakelearning.org/competencies/#steam
- [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.
- [STEM to STEAM](#) resources from the Rhode Island School of Design

- [Turning Green](#) a student led movement devoted to education and advocacy around environmentally and socially responsible choices for individuals, schools, and communities.

Marketing and Promotion

Many library staff spend a significant amount of time puzzling over the issue of "how to get teens into the library" and focus on marketing as a method for addressing this question. However, the key to well-attended programs is engaging teens in the planning process. If they are engaged in determining what programs the library will offer and have an opportunity to help with the planning, they will naturally be more likely to attend. They'll also be willing to help you market the program. You can also work with some of your community partners to determine a marketing strategy.

Make a marketing plan:

This step takes time, but is vital to your success. Consider your target audience – how will you get their attention? Also, think about what tools for marketing you have at your disposal, or that a partner could provide. There are a number of places to find resources for making a plan, adjust according to how big or small your STEAM initiative will be.

Take Pictures and Share them:

Start out easy. You take pictures, make sure they don't languish - share them on social media. According to Marwin Britto "The advent of the Internet has offered new cost-effective and wide-reaching marketing opportunities for public libraries." (Britto, 2014) Hopefully your library has at least one social media account through which to share your awesome programming. By recording what you are doing as you do it, you are creating the expectation that great things happen at your library. Use hashtags or clever tag lines that include "STEAM" specifically.

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.

Program at a regular time:

While you are planning, think about the success of story time. Storytime is a success partially because parents and children have the expectation that it will be there at the same place and time each week. Can you offer STEAM programming every week? Or maybe you are able to schedule it twice a month or the first Saturday of the month. Whatever your schedule, make it regular and easy to follow in order to build a flock of eager attendees.

Leverage the teens where they are:

Once you identify the particular teen audience you're trying to reach, that will help you determine the best location. For example, if you're trying to reach middle school students and the library is far from the school, it may be best for you to bring the programming to them.

Outreach is Marketing:

Do you have contacts local middle or high school? Ask the school librarian or science teacher if you can bring a program to them, either in the class or afterschool. As the [Boston Public Library](#) states on their web page, "Outreach extends services and programs beyond the library's physical and virtual spaces to offer equitable access to information and resources, especially to underserved and underrepresented populations." You being in the school and doing cool stuff is a real life advertisement for teens that the library may not be what they expect. You are the marketing initiative in this scenario. Defy expectations and build the idea of the library as a community for every teen.

Leverage other youth-serving groups:

You know the other youth serving organizations are in your area; make sure you let them know what you're doing and ask them how they could help get the word out. Or better yet, include them in the plans as you create a regular schedule. There may be funds for bussing kids from the YMCA or afterschool enrichment programs to the library once a month, or perhaps they are close enough to walk. Engage those organizations with your planning. Often, they are looking for inexpensive ways to engage and challenge their youth.

As with any programming or publicity, consider how to incorporate young adults into the process. How can you obtain teen input on social media? Do you know a teen who'd be willing to design flyers, create a short video, and/or talk up the program with their friends? Teens who are engaged in the planning and publicity process will be your best advertisers, because they feel invested in the program and want it to succeed.

If there's a university or college nearby that has a marketing or communications program, reach out to the faculty to see if they'd be willing to make marketing library programs a class project, or if they know of any students who'd be willing to volunteer their time to help you.

Evaluating Your Program

You planned a dynamic STEAM program, secured funding, created community partnerships, promoted widely and thoughtfully, and you had a solid turn out for your event. 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.

We've all carefully collected data that ends up sitting 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 share it with, 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? Check out YALSA's wiki, which has a section about evaluation and measurement. Evaluating Teen Services and Programs by former YALSA president Sarah Flowers offers more information on how to get started (Neal-Schuman, 2012 http://www.alastore.ala.org/detail.aspx?ID=4004). You may also want to look at the California Library Association's outcome-based summer reading project, which offers timely insight. Wilkerson and Hayden's "Effective Practices for Evaluating STEAM out-of-schooltime programs" is also a great resource.

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 STEAM events! If your events use a laptop or iPad, make sure your survey is electronic, using a free survey tool like SurveyMonkey or through Google forms. Both forms of surveys 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. You can get some very basic information on writing an effective survey in a number of places, but Survey Monkey has a good summary!

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 STEAM 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. This is also an excellent way to illustrate the data collected through surveys or attendance collection. Transformational stories you share with your community help to illustrate the 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. . In addition to pictures and jotted down notes, remember than video, so easily available on smartphones or iPads, is a way to share your teen's voices with administration directly. Wilkerson and Haden state, "…vignettes or descriptive narratives based on qualitative data can be an effective way to help facilitators "see" important nuances."

Creating a Rubric

When it comes to evaluating a STEAM program, you will have different expectations than for other programs. The focus of STEAM 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 STEAM programs. Review your action plan when creating a rubric. Decide which 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), your expected outcome is 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 STEAM 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 STEAM components	Relationship between program and STEAM is clear from the content	Relationship between program and STEAM needs explaining.	There is no relationship between the program and STEAM.
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 STEAM Stories

OK, you are almost done. Now it's time to get the word out again. But this time, share information about your successful STEAM initiatives and programs in order to make sure the community understands the value 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 STEAM 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://www.alastore.ala.org/detail.aspx?ID=3996

STEAM SPECIFIC SITES
- Are you a member of LinkedIn? Share your stuff on their STEM in libraries
- 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 STEAM 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 STEAM afterschool programs.

Best Practices

This section covers best practices related to STEAM 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 STEAM 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 STEAM 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 STEAM 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 STEAM 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 STEAM 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 STEAM 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 STEAM 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 STEAM 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 STEAM, 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 STEAM-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 STEAM 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 STEAM-related learning.
- Read the SLJ article "Full STEAM Ahead: Injecting Art and Creativity into STEM Programs"
- Out-of-school-time programs: If you put your mind to it, you'll discover numerous possible STEAM connections for the out-of-school-time programming you provide. Gaming sessions, candy sushi projects, digital content creation—all can have a relationship to STEAM. Every time you develop a new program, think about the potential STEAM associations and make sure to highlight those when talking with teachers, administrators, and parents.

Examples of Successful STEAM Programming

In order to give you an idea about what a solid STEAM-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 STEAM 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 STEAM education, the results of our efforts often manifest themselves well after the program has ended.

- STEM 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.
  - http://www.stemread.com/
- STEAM Works from Northern Illinois University is made up of programs and people committed to providing engaging interdisciplinary educational experiences
  - http://niusteamworks.com/
- In a blogpost, "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."

- - http://www.alsc.ala.org/blog/2012/03/beyond-legos-coding-for-kids/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+AlscBlog+%28ALSC+Blog%29
- Westport Public Library: Check out this great site to see how one public library has embraced STEAM through the maker movement. (For more about Makerspaces, read the next section.)
  - http://westportlibrary.org/services/maker-space
- Branched Out: 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.
  - http://www.sciencebuff.org/site/
- 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 STEAM learning for the sake of our community and its youth. In addition, STEAM has been the most successful type of programming we have offered, and we're committed to implementing it throughout the year in various ways."
- Don't overlook ALA's science related exhibits. 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.ala.org/programming/exhibitions
- Similarly, a few 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!

STEAM and Makerspaces

The past few years have seen increased interest in making and makers. 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 STEAM, makerspaces have the potential to demystify science, math, technology, and engineering; and encourage women and under-represented 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 STEAM 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/STEAM-engagement-maker-movement-annmarie-thomas

Libraries & makerspaces: A Revolution?
- http://tascha.uw.edu/2014/06/libraries-makerspaces-a-revolution/

The Library as Incubator: posts tagged "Makerspace"
- http://www.libraryasincubatorproject.org/?tag=makerspace

From the National Education Association: The 10 Best STEAM Resources:
- http://www.nea.org/tools/lessons/STEAM-resources.html

Maker Bridge: blog, resources and community for all but with a "focus on librarians, teachers and other educators.
- http://makerbridge.si.umich.edu/about/

Makerspace Resources
- Makerspace Directory: Find a makerspace near you at this comprehensive site.
- 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! These projects really tend toward the younger set.

- Maker Faire Homepage: Links to Faires all over the world.
- Makezine: Blogs, projects and contests from Make Magazine
- Howtoons: Cool easy to facilitate projects in comic book format.
- Instructables: great website that touches on all skill levels and price ranges.
- Diana Rendina has a solid resource page on her website Renovated Learning: http://renovatedlearning.com/makerspace-resources/
- Libraries & Maker Culture: A Resource Guide
- The YOUMedia Network is an online community of library and museum staff who provide connected learning experiences for and with teens through places such as makerspaces
  - Candice Mack has a 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
- Urban Libraries Council's list of Makerspaces in libraries
  - http://www.urbanlibraries.org/-makerspaces-in-libraries-pages-338.php
- The Harold Washington Library Center has the YOUmedia lab for teens. This space a teen learning space "with an emphasis on digital media and the maker movement". They also have a Maker Lab offering "free workshops, open lab hours and drop-in demonstrators."
- The Denver Public Library has the ideaLAB: it is both a makerspace and a media lab. Sporting specific hours for specific age groups.
- 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 Digital Studio on a smaller scale--proof that you don't have to have a large space to offer amazing digital tools to your patrons!
- The Fayetteville Free Library renovated a wing of their building to provide a permanent location for their Fab Lab. Many "making" technologies are also accessible in their Creation Lab, a smaller scale digital media lab.
  - http://fflib.org/make/fab-lab

Sample STEAM Programs
Need some help getting started? This 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 STEAM 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. Another resource to try is STEAM Art Lessons.

23 More Ideas to Get You Excited About STEAM
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 STEAM fields such as scientist and engineering for a STEAM 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 STEAM fields. STEAM 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 STEAM experts or organizations to talk to kids about their STEAM research projects and programs. Showcase your STEAM resources, collection, databases, etc. too.
8. 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.
9. Use the library computers and equipment to showcase digital media--make images, movies, and interactive media to compile in a digital zine.
10. Make book trailers with Flip cameras, Animotos, Blabbers, or other technology.
11. 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.)
12. Host an online book club or literature circles for teens on wikispaces.
13. Bring in a science show performer. Dave Maiullo from Rutgers University is great.
14. Have a TED Talk or Battledeck style series of local STEAM peeps giving 10-minute talks about an interesting STEAM story or narrate STEAM-themed slides.
15. Offer teens the chance to help create and/or maintain or revamp your library web site or blog.
16. Start a coding club or host a LAN party.
17. Have a Media Breaker class. This site has extensive resources in a kit format complete with everything someone needs to host an event about web design and media literacy.
18. Host a LEGO creation party and display your teens' works of LEGO art.
19. Host a C*areers in Medicine* night with local colleges, universities, or nursing degree programs.
20. 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.
21. Create Rube Goldberg machines.

22. There are lots more suggestions at "[Get Excited About STEM!,](#)" a guest post by Cindy Welch of YALSA's Editorial Advisory Board. It has some quick tips for getting started with STEAM programming at your library.
23. [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!

For more great programming ideas, be sure to check out YALSA's programming website, [Teen Programming HQ](#) at http://hq.yalsa.net.

Stealth STEAM 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 and a great way to promote the resources you have available. What's more, it's also 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 STEAM 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.
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. Big Huge Labs 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 STEAM, they must think like scientists:
- Hypothesis: This is the plan made for the STEAM program.
- Experiment: This is what happens when the STEAM 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 STEAM 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, STEAM education is worth doing.

Keep in mind that the library offers a unique opportunity to present STEAM 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. STEAM 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. STEAM 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 STEAM 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:
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

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?
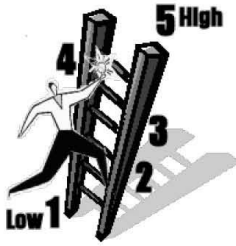Would you recommend a friend attend a future program?
What other topics would you like to see included in our programs?
Do you follow us on Facebook?
If not, why?
Any additional comments?

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 sySTEAMs. 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.

Extending the Program: Float Your Boat

- 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 (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.
2. Make sure that teens who do not have their own camera know whom in the library to ask about using the library's camera.
3. Taking Photos
    a. Teens will take a photo of the library (any angle, inside or out) and modify it using photo editing software.
4. Entries should reflect the theme of "Today at the Library…" and can include a short funny caption for the photo.
5. 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.
6. 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.
7. 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

- Strengthening Teen Services through Technology: Curriculum kit with ready to use training materials for library staff.
    o www.ala.org/yalsa/young-adults-deserve-best
- Teen Programming Guidelines: Outline of best practices in planning, delivering, and evaluating programs for and with teens
    o http://www.ala.org/yalsa/teen-programming-guidelines
- Teen Programming HQ: Find and share programming and other ideas relating to library services for and with teens
    o http://hq.yalsa.net
- Teen Tech Week™: Celebrated each year the second week of March
    o www.ala.org/yalsa/teentechweek
- *The Future of Library Services for and with Teens: A Call to Action*: Report from YALSA that provides information and recommendations for planning and delivering 21st century library service for and with teens.
    o http://www.ala.org/yaforum/project-report

- The YALSAblog: New content daily, including posts on topics such as tips for planning and evaluating programs for and with teens
  - http://yalsa.ala.org/blog/
- YALSA's Top Reads: STEM/Making Edition (tentative title): coming soon, a digital publication composed of YALSA's best articles and resources related to STEM and Making is currently in production and slated for publication in February 2017.
  - http://www.ala.org/yalsa/products%26publications
- YALSA Toolkits and pamphlets, including a Making in the Library Toolkit.
  - www.ala.org/yalsa/handouts
- YALSA Webinars: monthly webinars on a range of topics, including technology and programming. All webinars are free to YALSA members. Group registration is also available for a fee.
  - www.ala.org/yalsa/webinars