STEAM up your library

A guide to energizing your offer

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STEAM up your library: A guide to energizing your offer

Acknowledgements

This guide draws on the results of the STEM in Libraries Symposium hosted by the University of Edinburgh on 26th September 2019 and convened by Fulbright Global Scholar Keliann LaConte.

Many thanks to the presenters for providing examples to seed the discussions and to the participants for contributing their ideas and further resources. This guide is intended to collect these valuable insights and share them broadly.

See the Appendix for a list of the individuals who contributed to this guide and further details about the symposium.

Front cover photo credit: Keliann LaConte/Midlothian Science Festival

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Examples of STEM-related skills[1]

Active learning
Appreciation for diversity
Creativity
Critical thinking
Curiosity
Perseverance
Problem solving
Reading comprehension
Team work
Technical skills (e.g., programming, repairing, working with equipment)
Writing

A vision for STEAM programmes in public libraries

'STEM' is an acronym that is widely used in education, economic, and policy circles, especially in relation to science, technology, engineering, and mathematics workforce skills and opportunities. STEM disciplines encompass an array of topics and skills, and many of these are critical for work in the 21st century.[1] Many young people may not have a parent with a STEM degree — nor may their parents' social circles include STEM connections. Adults may also want to broaden their horizons for employment in STEM areas. By increasing access to STEM learning opportunities, these fields could be infused with people of mixed backgrounds and lead to fresh ideas.

There is a persistent myth that one may be proficient at STEM *or* the arts, but not both. Many library professionals have adopted the term 'STEAM' — which explicitly acknowledges the arts and creativity — to describe how they contribute to STEM agendas. Other library professionals prefer that reading and literacy also be explicitly included through the acronym 'STREAM'. STEM professionals benefit in *working across* sectors to solve large-scale challenges and generate new ideas. For those new to STEM content areas and skills, *learning across* content areas and tapping into the skill sets necessary for art and design may find entrée points to engage with — and add their own interpretation of — STEM. To acknowledge the importance of this interdisciplinary context, 'STEAM' will be the term used throughout this document.

Libraries have an important role in providing access to STEAM learning experiences to those who experience barriers due to economic situation, race, physical or mental abilities, geographic location, or other factors. Learners of all ages benefit from exposure to STEAM learning experiences through their local library. Libraries already offer a broad and rich range of content and resources and have a divested interest in engaging their communities in lifelong learning.

STEAM Planning Resources

Explore research led by Professor Louise Archer, University College London, into the concept of 'science capital', which considers how a variety of factors, including social networks, influence an individual's level of engagement with science.

[1] National Research Council. 2012. *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. Washington, DC: The National Academies Press. https://doi.org/10.17226/13398.

Stakeholders

The benefits of STEAM programmes in libraries can be measured from the perspective of three key stakeholders: internal library staff, external supporters, and customers[2] — both existing customers and new audiences brought in by STEAM programmes.

Credits: St. Tammany Parish Library (top); Keliann LaConte/Glasgow Life (middle); Keliann LaConte/Kingston Library (bottom)

To succeed, STEAM programmes must have buy-in from library staff, who contribute 'out of the box' thinking to undertake new directions. Ultimately, 'new' ideas can be tested and implemented more broadly across the library profession. Ideally, STEAM programmes result in external stakeholders perceiving the library as a place for new ideas and social experiences. Their support is also critical, both in terms of advocating for the library and providing sustainable funding to undertake STEAM programmes.

[2] Members of the public who visit libraries are referred to as 'customers' throughout this document. It is noted here that the terms "user", "patron", "borrower", or "member" might also apply.

Alignment with professional identity and ideals

Excellent customer service is at the core of the work that library staff and volunteers deliver. It is particularly valuable for a customer to find staff and volunteers to be welcoming, non-judgmental and approachable. Exemplary staff and volunteers are enthusiastic about meeting their customers' needs and spark their curiosity for learning more. This customer service focus allows library staff and volunteers to build relationships with their customers and understand current interests and motivational 'hooks' in the community. Library professionals are broadly trusted by both community members and other cornerstone institutions, such as schools and universities.

Library professionals can play a unique role in the life of a young person. They are not a parent or teacher, but serve the role of guide. When working with different age groups, library professionals apply their knowledge of tailoring lifelong learning to the individual's level.

Many professional skills of librarianship naturally align with facilitating STEAM experiences. Librarians are conversant with verbal reasoning. They have the skills necessary to interact with customers to understand their information needs and guide them to further learning.[3] These skills can be expanded to include comfort with uncertainty. As STEM fields continue to carry us forward into new frontiers, it will be increasingly important for individuals to have the skills to explore what is known and acknowledge that there is still much that remains unknown.

Libraries themselves are open to all and widely recognized as being a safe environment for intergenerational learning and leisure — across all topics and disciplines. Their books and other resources offer avenues to learn more about any topic. In contrast to schools, libraries are not focused on a particular curriculum, and they may have greater flexibility to orient around trending topics. Customers can feel comfortable in libraries as a space where knowledge and skills are not examined as 'right' or 'wrong', and learners may feel freer to make mistakes. Libraries are embedded as 'the community living room' and welcome individuals from any background, physical and mental ability, and economic situation. Ideally, the library space is designed to enhance this role.

Alongside these many advantages, many library staff lack formal training in STEM disciplines. They may have the same uncertainly with a STEAM topic as their customers.

[3]Baek, John Y. The Accidental STEM Librarian: An Exploratory Interview Study with Eight Librarians, October 2013.

Value for your community

In what ways might STEAM-related services change citizens' perspectives about libraries in the 21st century?

Libraries, their customers, and STEAM

Libraries and their perceived value

Libraries are widely regarded as community venues that welcome all. The *Shining a light* publication set documents the extent of both the perceived value and use of public libraries by members of their communities in England, Northern Ireland, Scotland, Wales and Ireland. In each of these jurisdictions, around:

~ 75% of people say libraries are important to the community

~ 50% of people use the library

~ 21-30% of people who rarely or never read books use the library

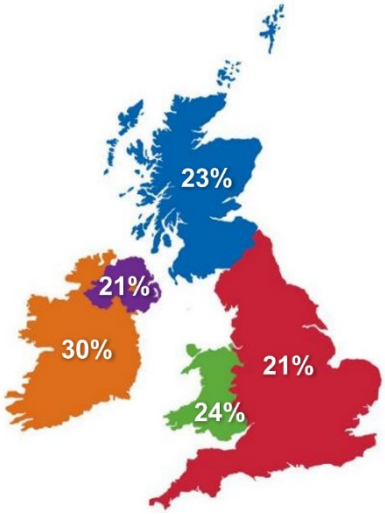

Figure 1. Non-readers use the library. Surprisingly, they make up 21-30% of library users. Image courtesy of Carnegie UK Trust.

There is a significant disconnect between libraries' perceived value for the community versus to the individual: Only around 40% of people in each jurisdiction say that libraries are important to themselves personally.

STEAM planning resource

Review additional statistics in the *Shining a light* policy report, data booklet, and country factsheets at carnegieuktrust.org.uk/shining-a-light.

Selecting your audience

For whom would you like to offer STEAM learning opportunities?

Would you target those at a particular stage of life, such as families with children in the household?

Or, are you looking to attract non-users with new STEAM opportunities?

Why do you want to engage with them?

What stakeholders could represent their interests in future conversations?

How might STEAM overlap with their interests and goals?

Diverse audiences

According to *Shining a light*, the following audiences are more likely to be library users:

- Have children in the household
- Be a "prolific" reader (and read at least one book every eight weeks)
- Be in the age range of 15-24 as opposed to over 55

However, the jurisdictions have notable differences in library use. For example, being a woman is a predictor for use in England, Ireland, Northern Ireland, and Wales – but this generalisation doesn't hold true in Scotland. In England, Northern Ireland, and Wales, being in the least deprived socioeconomic groups (A, B, and C1) was also a predictor for library use. In terms of, employment status, not working was a predictor for the likelihood of library use in Northern Ireland and Ireland but not elsewhere.

Clearly, libraries are used by people who bring varied preferences and enjoy varying levels of socioeconomic position. It is critical to gather information and avoid making assumptions about libraries and their users – especially when it comes to designing STEAM programmes.

STEAM Planning Resource

For example, library staff might want to engage with 13-18-year-olds who are at risk of dropping out of formal education. To better understand youth's interests and develop the goals for the programme, library staff could engage with leaders of friendship groups and ask for input. After giving the youth a voice, it would be essential to follow through and validate their feedback. There could be no 'winging it' with this age group, so partnerships would be essential to designing and implementing an engaging STEAM programme.

Revamp your approach for working with this age group using resources such as Developing Principles for Working with Young People in Libraries and Teens First: Re-imagined Library Services for and with Teens Infographic.

Customizing STEAM services

How might STEAM learning opportunities fulfil customer needs for events, while also striking a balance between entertainment, leisure, and learning?

How might STEAM-related services be customized for a key audience?

What types of STEAM-related services might customers prioritize?

STEAM opportunities are most successful in libraries when they capitalize on the library as a space that combines entertainment, leisure, and learning.

Shining a light analyses input from the people of the UK and Ireland regarding the most popular changes and improvements in library services across jurisdictions and within segments of populations, such as gender, socioeconomic status, age, and other factors. Among the possible library services ranked in the study, consider how the following connect with STEAM learning in libraries:

- Offering more events
- Offering more 'maker' activities
- Improving the range and quality of books

Across all jurisdictions, potential customers asked for more events. Indeed, events are among the top-ranked improvement among deprived socioeconomic groups in England, Northern Ireland, and Wales. Events are the top improvement among 25-34-year-olds across all jurisdictions, and, with the exception of Ireland, among those with children. Men in England, Northern Ireland, and Scotland ranked events as their top improvement.

While maker activities were identified as an improvement by 41-53% of library users, they are ranked relatively low by non-users (selected by only 22-34%).

Improving the range and quality of books was ranked as an improvement for 54-76% of library users, but this was true for only 27-44% of non-users.

Whatever libraries seek to offer — STEAM-related or otherwise — it is critical that those services are better communicated to potential customers. *Shining a light* research revealed how poorly citizens understood their libraries. For example, some potential customers wanted to look for or reserve books online — even though this service is already available. *Shining a light* researchers also took time to explain *what* a maker activity was — but there is a real need for people to understand *why* they might need or want that service.

The aforementioned statistics provide valuable perspectives, but are not intended to be taken as predictors of what potential library customers will actually do. The statistics can be a springboard, from which to reflect on learning from actual experiences locally as well.

Supporting underserved audiences

There are many benefits to developing skills associated with the sciences and related disciplines. (See the example skills listed at left.) For young people, developing skills in STEM-related disciplines opens up career opportunities in a future we can scarcely even imagine. They are also valuable skills for adults seeking new career pathways. Beyond just the workforce, such skills are essential for navigating a 21st century life.

Young people in the UK have positive feelings about science and related disciplines and the contributions of such careers to society. Yet, many youth don't identify with science, and so don't continue to study science subjects. These identity concerns are related to gender, socio-economic status and extent of family connections to science.[4]

Libraries in the U.S. have had success in working with their communities to define what STEM offerings might best support underserved groups through 'community dialogues'.

STEAM Planning Resource

Tip: Host a 'Community Dialogue' to discover more about how community members think and feel about science and technology learning. A 'Community Dialogue Guide' and other planning resources for public libraries are available from:
starnetlibraries.org/resources/community-dialogues

[4] Rebecca Hamlyn, Peter Matthews and Martin Shanahan. Young people's views on science education. Science Education Tracker Research Report, February 2017.

Promoting STEAM learning opportunities

According to *Shining a light*, the public needs better information on what services library offer and why the public might want to participate. Consider the following strategies for engaging underserved and underrepresented audiences.[5]

Figure 2 At the Loanhead Library (Scotland), colourful signage invited library customers to try an array of STEAM activities. Credit: Keliann LaConte/Midlothian Science Festival

Strategy 1 Make promotional materials relatable and meaningful to your target audience

Strategy 2 Take your STEAM event on the road

Strategy 3 Find community partners — especially those that serve the target audience!

Strategy 4 Offer flexible ways for people to engage with STEAM materials

[5] Keliann LaConte and Jen Jocz. Challenges and Strategies for Engaging Underserved and Underrepresented Audiences in Informal STEM Learning: Lessons Learned from Project BUILD. STAR Library Network weblog, July 26th, 2019.

Designing STEAM programmes for impacts

Effective STEAM programmes can be organised around the three tenants of **purpose**, **people**, and **process**, with evaluation at its centre.

A useful framing for the purpose of STEAM programmes is provided by the Public Engagement Triangle:[6] You might wish to inspire, inform, educate, or otherwise **transmit** information. Or, your purpose might be to **receive** the perspective, skills, or other input from the public in order to inform your next steps. Or, perhaps you are looking to **collaborate** with the public to create a product or consider an issue together.

Figure 3 Dr Ingrid Jüttner (left) engages customers at Fairwater Library (Wales) in conversations about museum specimens. The purpose of the event was to inform library customers about the importance of wildlife. Credit: Amgueddfa Cymru.

At the end of a programme, you might hope to have achieved any number of outcomes. These are typically:

Outcomes

- Changes or differences we hope to make
- Characterised by a 'change' word: e.g. increase, reduce
- A statement that includes who, what, and how

How do you keep track of your progress along the way? Distinct from more overarching outcomes, indicators enable you to collect pertinent data that can be used to assess the degree to which an outcome is being (or has been) achieved:

Indicators

- Neutral statements
- Measurements taken on more than one occasion

STEAM Planning Resource

From the earliest stages of your project, map out the aim(s), various participants to be involved, resources needed, major activities, and the results you hope to achieve. See Appendix C: Project Planning Template for inspiration!

Tip: Be sure to share your plan with team members and collaborators for their input throughout the life of the project.

[6] National Co-ordinating Centre for Public Engagement, https://www.publicengagement.ac.uk/do-engagement/quality-engagement/about-quality-engagement

STEAM Planning Resources

The impacts of STEAM programmes on library customers may be diverse and it is critical to capture those impacts through evaluation. Evaluation tools and resources can be accessed through a variety of organisations, such as:

Evaluation Support Scotland

Public Library Association's Project Outcome

Measures of Connected Learning

Center for Youth Program Quality

The PEAR Institute's Dimensions of Success

Makerspaces Framework

Of course, it can be extremely complicated to understand how a given experience can feed into a person's overall trajectory in life, where her/his decisions are shaped by a variety of influences. It is becoming increasingly important to consider how an individual moves through learning experiences in a given community. For many young people, school is a cornerstone piece of this experience — but it's certainly not the only one. Experiences at home, online, at places of worship and in libraries, and more contribute to an individual's learning trajectory.

Libraries already connect with many of the critical institutions in a community. But how can those relationships be developed toward a connected system? To borrow a term from the sciences, a learning 'ecosystem' would entail the disparate organisations and key individuals in the community working together to support the learning of their community members.

Examples of STEM-rich learning experiences provided by libraries

Art-based STEM activities
Career-focused STEM activities
Citizen science projects
Coding
Demonstrations
Design-based learning
Discussions
Documentary showings
Excursions to your library
Hands-on STEM activities
History-based STEM activities
Interactive exhibits
Lectures
Makerspaces/creative spaces
Robotics
STEM kits circulated to customers
STEM "event-in-a-box"
STEM-related reading events
STEM-related storytimes
Science Cafés
Sky gazing nights
Tech classes

…and more…

STEAM offer: examples and ideas

Libraries connect their audiences to STEAM explorations in a variety of ways, including:

- Activities facilitated by library staff
- Take-home kits
- Interactions led by STEM experts
- …and more…

STEAM activities

STEAM learning in libraries takes a variety of different forms, such as those listed on the left.

In Australia, state, public and school-based community libraries rank active and 'hands-on' activities among their top offerings. These include hands-on STEM activities, coding, art-based STEM activities, tech classes, and robotics.[7,8]

To fuel such a diverse array of offerings, library staff identified a need for resources and training. Library staff in both the U.S. and Australia rank how-to procedures for facilitating activities as their top need.[9]

Multiple organisations provide free how-to procedures for facilitating hands-on STEAM activities, games, crafts, and demonstrations. These are listed throughout this section to offer your customers with entry points into science, technology, engineering, art, and mathematics.

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[7] Based on 104 responses. See LaConte, K. (May/June 2019), Libraries & STEM Learning: Recommendations for Future Collaborations Based on a National Survey. *INCITE* (pp. 24-25), vol. 40, no. 5/6.
[8] LaConte, K. Libraries & STEM learning: results from a survey of Australian libraries (2019), Deakin, ACT: Australian Library and Information Association.
[9] Hakala, Jim S., Keelin MacCarthy, Carissa Dewaele, Marcella Wells, Paul Dusenbery, and Keliann LaConte. 2016. STEM in Public Libraries: National Survey Results. Boulder, CO: University of Colorado.

Science

Science explorations allow customers to “play” with concepts such as force and motion, density, states of matter, and more. Such activities can give learners opportunities to ask their own questions and practice critical thinking.

Figure 4 The Midlothian Science Festival brings university and industry expertise into libraries and other community venues annually. Credit: Keliann LaConte/Midlothian Science Festival

STEAM Planning Resources

Through citizen science projects, community members can cultivate their own curiosity and contribute to science research, often relating to locally relevant issues. Here are a few projects:

Big Butterfly Count

Dark Sky Count

GLOBE Observer

iSpot

Nature’s Calendar

Technology

Figure 5 Peverell Library (England) promoted its micro:bits for circulation through a display. Credit: Julia Chandler/Libraries Taskforce.

Technology is being offered through libraries so that community members can be creators — not just consumers — of digital content.

For example, Libraries NI have 500 micro:bits — with YouTube clips and worksheets — available to borrow through all branches, and 1,500 more will be added to circulation. Micro:bits are featured in class visits by Year Six pupils, as well as in workshops for children aged 10+ years. Further sessions are planned for 2020.

Find inspiration on Twitter at #microbitsinlibraries.

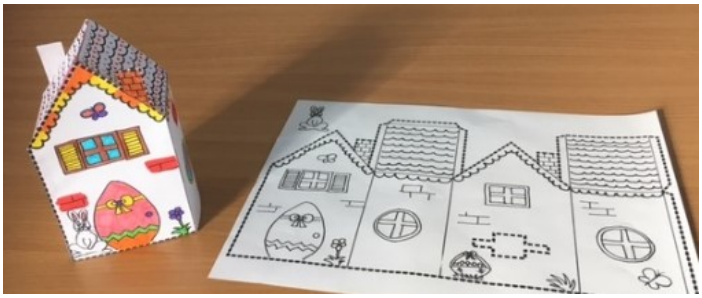

Figure 6 Children made holiday-themed nightlights at a recent micro:bit workshop. Credit: Libraries NI

ENGINEERING

Engineering design challenges are often open-ended, with no fixed 'solution'. Such activities can help learners build confidence in their creative abilities, while also developing persistence and critical thinking skills. By framing an activity as an everyday 'problem' that needs a 'solution', customers of all ages can be invited to explore materials and create their own designs.

Figure 7 'Balloon rocket cars' allow library customers to create their own vehicles using inexpensive, common materials. Credit: Keliann LaConte

STEAM Planning Resources

STAR Library Network

The Space Science Institute's National Center for Interactive Learning provides hands-on activities, resources, and training to library professionals through its Science-Technology Activities and Resources Library Network (STAR Net). Core partners include the American Library Association (ALA), Urban Libraries Council, Cornerstones of Science, American Society of Civil Engineers, and many other organizations. Access the following FREE STAR Net resources:

STEM Activity Clearinghouse
Search the STEM Activity Clearinghouse for hands-on STEM activities for all age levels and related resources. Use search tools to filter activities by content area, age group, time to complete activity, time needed to prep activity, cost associated with activity materials, difficulty level (by content), or mess level.

'How-to' Tutorials
View brief video clips on how to implement a variety of hands-on STEM activities, as well as more in-depth archived webinars on STEM programming resources.

Blog
See examples of STEM programs that are being implemented in libraries.

STEM Kits
Explore how libraries are making STEM kits available to their customers, including considerations of how to plan, catalogue, and manage such collections.

Art

While creativity is an integral part of all STEM disciplines, including the arts explicitly can provide make activities more accessible. Art activities allow customers to make a statement about their own perceptions of the topic at hand.

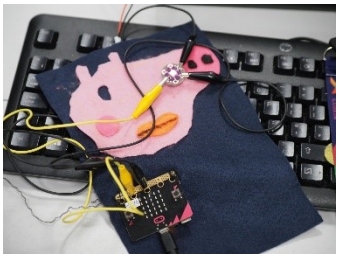

Figure 8 A teen integrated both crafts and music into this project, which evolved over the course of several weeks. Credit: Keliann LaConte/Glasgow Life

Mathematics

Mathematics underlies many of the pursuits we seek for fun and entertainment. For example, some libraries offer block play for young children, giving them access to three dimensional shapes that help them develop spatial skills. Mathematical challenges can be incorporated into 'escape room' events for adults, and older children and teens can play strategy games with mathematics embedded within them.

Figure 9 Families explored a variety of maths activities at Loanhead Library (Scotland), including maths challenges (left) and play with geometric shapes (right). Credit: Keliann LaConte/Midlothian Science Festival

STEAM Planning Resource

Pard, Chantale. *STEM Programming for All Ages: A Practical Guide for Librarians*. Lanham, MD: Rowman & Littlefield Publishers, 2018.

Take-home kits

With the explosion of commercially available STEAM education materials, libraries have taken on the role of curating those materials so that they can be shared among community members. Kits extend the learning to the home setting and allow library customers to participate in STEAM learning as they have the time.

Figure 10 An example STEM Kit. Credit: Edinburgh City Libraries

Interactions led by STEAM experts

Community members have their own expertise to contribute, and many libraries actively seek out local STEAM expertise to highlight through events. R. David Lankes, professor and the director of the University of South Carolina's School of Library and Information Science, notes how library professionals are well-prepared to curate community expertise in this way:

> *When we talk about collection development we think about selecting, acquiring, organizing and circulating books and materials. These same "meta" skills (locating, organizing, preparing, providing access) can be applied to the community itself…. Once they identify experts, they work to provide that expertise to the rest of the community.*
>
> - R. David Lankes, Expect More: Why Libraries Cannot Become STEM Educators

For example, Libraries NI hosted events with author and wildlife photographer Dr Michael Leach, who also has filmed more than 60 TV documentaries for the BBC and Independent Television and travelled to all 7 continents.

Figure 11 Dr Leach captivated his audiences with tales and photographs of his travels. Credit: Libraries NI

STEAM Planning Resource

Meet scientists from around the world through Skype a Scientist.

STEAM Planning Resources

STEM Learning

STEM Ambassadors
Access 33,000 active STEM Ambassadors across the whole of the UK, who are experienced STEM professionals willing to give their time freely to support STEM related activities and events.

STEM Ambassador Hubs
There are 19 STEM Ambassador Hubs across the UK, and their role is to coordinate the volunteering opportunities for STEM Ambassadors. They also offer a range of support and opportunities, provide local expertise, and develop links between groups and individuals.

STEM Clubs Programme
Borrow free resource kits: 'Movies and Magic' for 9-11 year olds and 'Movie Music' for 11-14 year olds. Each resource kit contains the equipment and tools needed to run eight activities (serving 16 young people at a time). Both resources are supported by online 'How to' videos.
Movies and Magic Activity Download
Movies and Magic 'How to videos'
Movie Music Activity download
Movie Music 'How to videos'

STEM Clubs Themed Activity Resources
Find free activities such as Zombie Apocalypse, Survive an Asteroid Impact, Extreme Elements, and more. The themed activities are designed to serve youth ages 7 to 16.

ESERO-UK
Access free resources, support and information to anyone looking to use space as a STEM activity, including Mission X.

Resources
Access several thousand quality assured, free activities and project ideas.

Skills Builder Framework
Learn about eight essential employability skills that can be developed through STEM activities: listening, presenting, problem solving, creativity, staying positive, aiming high, leadership and teamwork.

Collaborations to develop a STEAM 'ecosystem'

In both the U.S. and Australia, lack of staff time and funds are the top barriers to beginning or increasing STEM-related events and services.[5,8] In light of these challenges, collaborations are key to an effective — and sustainable — STEAM programme.

> *In a context where resources are under pressure and the development capacity of services has been diminished, working in partnership with 'unusual friends' can provide an effective way of delivering positive outcomes for all. Moreover, collaboration with those that are not naturally aligned with public libraries can be an effective form of advocacy for the library service and what it has to offer potential partners and the public.*
>
> - Dr Jenny Peachey, *Shining a light*

STEAM Planning Resource

Museum-University Partnership Initiative

Partnership resources are available from the National Co-ordinating Centre for Public Engagement to facilitate a discussion between your team and a potential partner. Download and print a card game that can be used to develop the purpose, priorities, and lifecycle of your partnership.

Library-university collaborations

Consider, for example, how public libraries and higher education institutions share many mutual priorities. According to a recent survey, there is interest on the part of both public libraries and higher education representatives in partnering (96% and 88%, respectively).[10] A library-university collaboration around STEAM learning might lead to an array of benefits for stakeholders, such as:

Library

- New types of learning experiences
- Continuing professional development for staff
- Attract new customers
- Increase footfall
- Expand customers' horizons

University

- Insights from library staff, the 'community gatekeepers'
- Book circulation records as indicators of programme impact
- Access to a community space
- Building a legacy of STEAM learning in the community
- Links between science and other disciplines
- Access to 'hard to reach' members of the public

Library customer

- Fun, creative learning experiences
- Connections between STEAM and everyday experiences
- Age-appropriate explorations
- Social engagement (across generations)
- Exposure to what universities have to offer

Figure 12 Through a collaboration between the University of Edinburgh and Edinburgh City Libraries, Dr JC Denis led some 'potions classes' (left and centre) and children made a variety of mixtures (right) at a STEAM event in 2018. Credits: Dr JC Denis and Katie Swann

[10] Pekacar, Katie. Higher Education and Public Libraries: Partnerships Research, A report for Arts Council England, November 2018.

Science festivals

Science festivals engage their local community through a series of events held at multiple venues. Libraries are proving to be critical partners in such community-scale endeavours. Through collaboration and coordination, festival partners have greater promotional reach than they would by acting alone.

Libraries NI is a partner in the prestigious and innovative Northern Ireland Science Festival, which is now approaching its sixth year. Forty-seven different organisations partner to deliver over 190 events in more than 50 venues. These organisations include art and cultural centres, STEM-related institutes and societies, higher education providers, government departments, and businesses. In 2018, Libraries NI hosted the high-profile launch event in Belfast Central Library, where the audience could get an insight into some of its science-related treasures, including a letter from Albert Einstein and patents for microscopes. In 2019, the group Science Stars delivered four interactive workshops at branch libraries, reaching 170 children with hands-on experiences.

The Midlothian Science Festival grew in 2012 out of a mutual need for Midlothian researchers and industries to connect with their local communities and the Midlothian libraries to offer science engagement. Since then, the festival has grown to nearly 80 public events, with roughly a third offered at libraries. Below are just a few examples of 2019 festival events offered in libraries.

he public was enticed to participate in events through n active social media presence and printed materials. Promotional materials highlighted cutting-edge science and technology and detailed how the event would be creative and fun for the target audience (families, teens, or adults).

Through advanced online booking online, artists and scientists signed up to work in pairs to creatively communicate scientific discoveries through the Art & Science on a Postcard event.

Figure 13 Example flyer promoting a Midlothian Science Festival Event. Credit: Loanhead Library (Scotland)

In one event, researchers teamed up with a knitting group to teach library customers how to create their own ‘nerve cells’ made from yarn.

Figure 14 Knitted models of nerve cells were created at a festival event and then put on display. Credit: Roslin Institute

At another library, a local gaming club invited the public to play science-themed board games and enjoy family time on a rainy Saturday.

Figure 15 Napier University psychologists facilitated conversations over tea, coffee, and cake at Dalkeith Library (Scotland). Credit: Dawn Smith/Midlothian Science Festival

For an adult-focused event, university psychologists invited library customers to spend some time at gingham-covered tables in the stacks and enjoy cakes and conversation. Customers brought their own questions about mental health, the workings of the mind, and other topics and chatted in a stress-free environment. The event was intentionally offered at midday to serve those who might not have had the opportunity to have formal higher education.

STEM expertise / resources available in communities

Aquariums

Art galleries/museums

Botanic gardens

Coding education franchises or charities

Community groups/clubs for underserved individuals

Festivals

Further Education institutes/colleges

Government departments, agencies and public bodies

Health professionals

Historic environment organisations

Industries

Makerspaces

Science or discovery centres/museums

Not-for-profit organisations

Non-university research institutes

Observatories

Other libraries

Primary schools

Volunteer “ambassadors” of STEM subjects

Secondary schools

Theatres

Universities

Zoos

…and more…

Together, STEAM opens possibilities

Collaborations are a powerful tool for providing communities increased access to STEAM learning opportunities through their local libraries. STEAM collaborations may begin with just a single event that demonstrates the potential for the relationship. Or, the collaboration may entail a series of activities to support a given focus, such as a summer reading theme. In many cases, libraries and their collaborators find success in evolving their STEAM offer over the course of many years, as in the case of several science festivals across the UK.

Figure 16 Industry members showcase cutting-edge STEM careers in the community. Here, a technician from Casta Spes engages customers of all ages at Dalkeith Library (Scotland) — from children to retirees — in how a robot helps provide security. Credit: Keliann LaConte/Midlothian Science Festival.

Appendix A: Contributors

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Carnegie UK Trust

Jill Munro
Wester Hailes Library

Joanne Mitchell
STEM Learning, National STEM Learning Centre

Juliet Ridgway
Midlothian Science Festival

Katie Pekacar
Independent Mind

Keliann LaConte
Fulbright Global Scholar

Ken Aitchison
Midlothian Science Festival

Kirsty Ross
University of Strathclyde

Laura Molnar

Lewis Hou
Science Ceilidh, Fun Palaces

Mat Hickman
Wellcome Trust

Simon Kelley
University of Edinburgh

Stuart Dunbar
University of Edinburgh

Sue Williamson
Arts Council England

Valerie Christie
Libraries NI

Appendix B: STEM in Libraries Symposium information

Goals

- Network across sectors
- Explore promising directions for STEM collaborations to build upon existing library priorities and services
- Identify areas for productive sharing of resources and strategies from the U.S. 'STEM in Libraries' movement

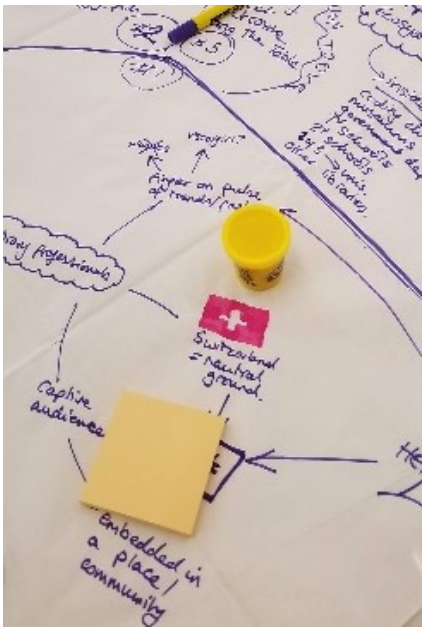

Figure 17 Participants developed ideas across a variety of topics through a combination of presentations, discussions, and drawing and writing.

Presenters

Jean-Christophe Denis
University of Edinburgh/Ogden Trust
Dr JC Denis is an Ogden Outreach Officer at the School of Physics and Astronomy, University of Edinburgh. He focuses on working with the local community to raise the science aspirations of children and families, through repeat interventions and supporting educators. He has worked with libraries, linking Harry Potter with science, and developing activities for the Space Summer reading challenge, and is looking forward to working with libraries more!

Jenny Peachey
Carnegie UK Trust
Dr Peachey leads the Carnegie UK Trust's Future of Public Libraries work. In this role she has published a series of policy and research reports on public libraries in the UK and Ireland, contributed to the development of Scotland's first National Strategy for Public Libraries and is programme manager for Carnegie Library Lab and Engaging Libraries. Jenny also launched Speaking Volumes, an advocacy resource for public libraries, and liaises with a range of stakeholders in her work. Her background is in social research.

Keliann LaConte
Over the past decade, Keliann LaConte has worked with library, educati7on, and STEM professionals to support the "STEM in libraries" movement in the U.S. As a 2018-19 Fulbright Global Scholar, Keliann is conducting research and professional development on the topic of STEM learning in libraries in Australia and the UK. Keliann is the Principle Investigator of the project 'Enhancing STEAM Equity and Learning Opportunities in Libraries and Their Rural Communities', which is generously funded by the National Science Foundation. She is the co-manager of the NASA@ My Library initiative, which is funded by the NASA Science Mission Directorate and provides hands-on NASA activities, kits, and training to public and state libraries, nationally.

Kirsty Ross
University of Strathclyde
A microbiologist by training, Dr Ross now works with researchers from Strathclyde, Edinburgh and St Andrews Universities to support their efforts to engage others with their research. For the past three years she's worked with colleagues at Midlothian and Edinburgh City Libraries, as well as via the Midlothian Science Festival, to reveal the (potential) science that underpins the magic of the wizarding world!

Stuart Dunbar
University of Edinburgh
Stuart manages the delivery of an integrated portfolio of on- and off-campus public engagement events involving collaboration with academic colleagues, professional services staff, and students. He chairs the College of Science and Engineering's Public Engagement Advisory Group, which is currently addressing medium-term priorities to enhance public engagement practice. Furthermore, Stuart instigated the Young SAGE group: a collaboration with local 16-17 year olds to explore insights from young people around their science experiences (https://ypagdunbar.wordpress.com).

Agenda

Edinburgh Centre for Carbon Innovation (ECCI)
Thursday, 26th September 2019

13:30 **Welcome**
Simon Kelley, Professor of Isotope Geochemistry and Head of the School of GeoSciences, University of Edinburgh

Orientation and Introductions
Keliann LaConte, Fulbright Global Scholar

Small-group Discussion 1: STEAM and Library Professionals

15:00 **Networking Break**

15:15 **Presentation: Highlights from 'Shining a Light'**
Jenny Peachey, Senior Policy And Development Officer, Carnegie UK Trust

Small-group Discussion 2: Supporting Underserved Audiences

Presentation: Libraries and Universities: A Match Made in Heaven?
Jean-Christophe Denis, Ogden Outreach Officer, University of Edinburgh
Kirsty Ross, Outreach Officer, University of Strathclyde

Small-group Discussion 3: Collaborations to Sustain a STEAM "Ecosystem"

Presentation: What's the Impact of Your Engagement?
Stuart Dunbar, Engagement Manager/PhD Candidate, University of Edinburgh

Small-group Discussion 4: Measuring Impact

Wrap-up: Action Items and Final Comments/Questions

17:00 **Close**

Appendix C: Project Planning Template

<table>
<tr><td colspan="2">What is the long term change you want to achieve? (Aim(s)):
Examples:
▪ Increased knowledge of colleagues/families of those engaged
▪ Practice change in institution of those engaged
Note: be specific about the practice you want to change
▪ Those engaged empowered to train/engage others</td><td colspan="2">Who will be involved? (Participants):
Think of everyone (internal / external) who will participate</td></tr>
<tr><td>How will participants benefit in the short-term? (Outcomes)</td><td>What are the immediate results of the engagement? (Outputs)</td><td>What will you do as part of this engagement? (Activities)</td><td>What do you need to achieve your aims? (Inputs)</td></tr>
<tr><td>Intended <u>short-term</u> benefits or changes.

Examples:
▪ Increased knowledge of those engaged
▪ Change in practice of those engaged
▪ Improved confidence of those engaged

Note: These should be proportionate to the available inputs. You can’t save the world with one workshop…</td><td>The direct results of an activity/programme – usually these are things that can be counted e.g. an event; new webpages; involved people; number of workshops</td><td>What specific activities will you do?</td><td>What resources are required (or available) to achieve the aims/objectives of strategy (or possibly a programme/ activity)?

Note: If you find the required resources aren’t available you can either revisit your aims or seek out alternative sources of funding/staff/materials</td></tr>
<tr><td colspan="2">What are you taking for granted? (Assumptions):
e.g. activities are suitable; people interested in planned engagement; planned partnerships will be possible. If longer term the engagement isn’t having the desired impact you may want to revisit the assumptions – maybe they are wrong?</td><td colspan="2">What issues could arise? (Challenges):
e.g. different priorities; change in circumstances; rival projects</td></tr>
</table>

Figure 18 Project planning template. Courtesy of Anne Marte Bergseng and Stuart Dunbar, University of Edinburgh