A Resource Round-Up of 2019

The Year in Informal STEM Education

caise | center for advancement of informal science education

About CAISE

The Center for Advancement of Informal Science Education (CAISE) works to build and advance the field by providing infrastructure, resources, and connectivity for educators, researchers, evaluators, and other interested stakeholders. As the resource center for the Advancing Informal STEM Learning (AISL) program within the Division of Research on Learning In Formal and Informal Settings (DRL) at the National Science Foundation (NSF), CAISE seeks to characterize, highlight, and connect quality, evidence-based work on informal STEM learning.

Through **InformalScience.org**, we provide access to an ever-growing repository of more than **8,600 resources,** including project descriptions, research literature, evaluation reports, and other documentation. In 2019, CAISE added 246 resources to the collection and expanded access to mass media and communications research through EBSCO Information Services. CAISE also hosts the **NSF AISL Principal Investigator meetings** and convenes **task forces** and **workshops** that facilitate discussion and identify needs and opportunities for informal STEM learning researchers and practitioners. We are one of several NSF-funded resource centers that support NSF-funded professionals working in formal or informal STEM education. Others include the following:

Center for Innovative Research in Cyberlearning
(CIRCL, **circlcenter.org**)
Supports NSF's Cyberlearning program.

Community for Advancing Discovery Research in Education
(CADRE, **cadrek12.org**)
Supports NSF's Discovery Research preK-12 (DRK-12) program.

CS for All Teachers
(**csforallteachers.org**)
Supports all teachers of computer science to preK through high school students.

EvaluATE
(**www.evalu-ate.org**)
Supports NSF's Advanced Technological Education (ATE) program.

INCLUDES National Network
(**www.includesnetwork.org/home**)
Supports and serves the NSF INCLUDES National Network

STEM Learning and Research Center
(STELAR, **stelar.edc.org**)
Supports NSF's Innovative Technology Experiences for Students and Teachers (ITEST) program.

Introduction

The *Year in Informal STEM Education* is a **slidedoc** designed to identify and characterize field growth, change and impact, important publications, events, and themes that shaped 2019. Our goal for this resource is to add texture to the understanding of the evolving ecosystem of STEM learning, communication, and engagement. We hope that in these slides readers identify work related to their own efforts and interests as well as possibly encounter new areas to explore. In this way, these resources are intended to inform ongoing development of projects, programs, partnerships, or proposals.

Scope

This collection provides a selection of resources and events that emerged in 2019 that were notable and potentially useful for the informal STEM education field. It is not intended to be comprehensive or exhaustive, nor to endorse these particular resources. To manage the scope and length, we have focused on meta-analyses, consensus reports, compendia, publications, and the launch of initiatives that we hope will have *general relevance* for Informal STEM Education design, research, and practice.

Process

To identify content, we asked representatives from professional associations, institutions, and networks to share with us what was important in their ISE sector. Once again this year, we are extremely grateful for their input. Please note that many resources are relevant for multiple fields, particularly those pertaining to youth. Be sure to check out multiple sections!

We welcome your feedback on what you found useful, how we might improve this resource, and what should be included in the 2020 year in ISE! Please send your suggestions to caise@informalscience.org

Types of Resources Included

By the Numbers

Data, trends, and geographic locations

Select Publications

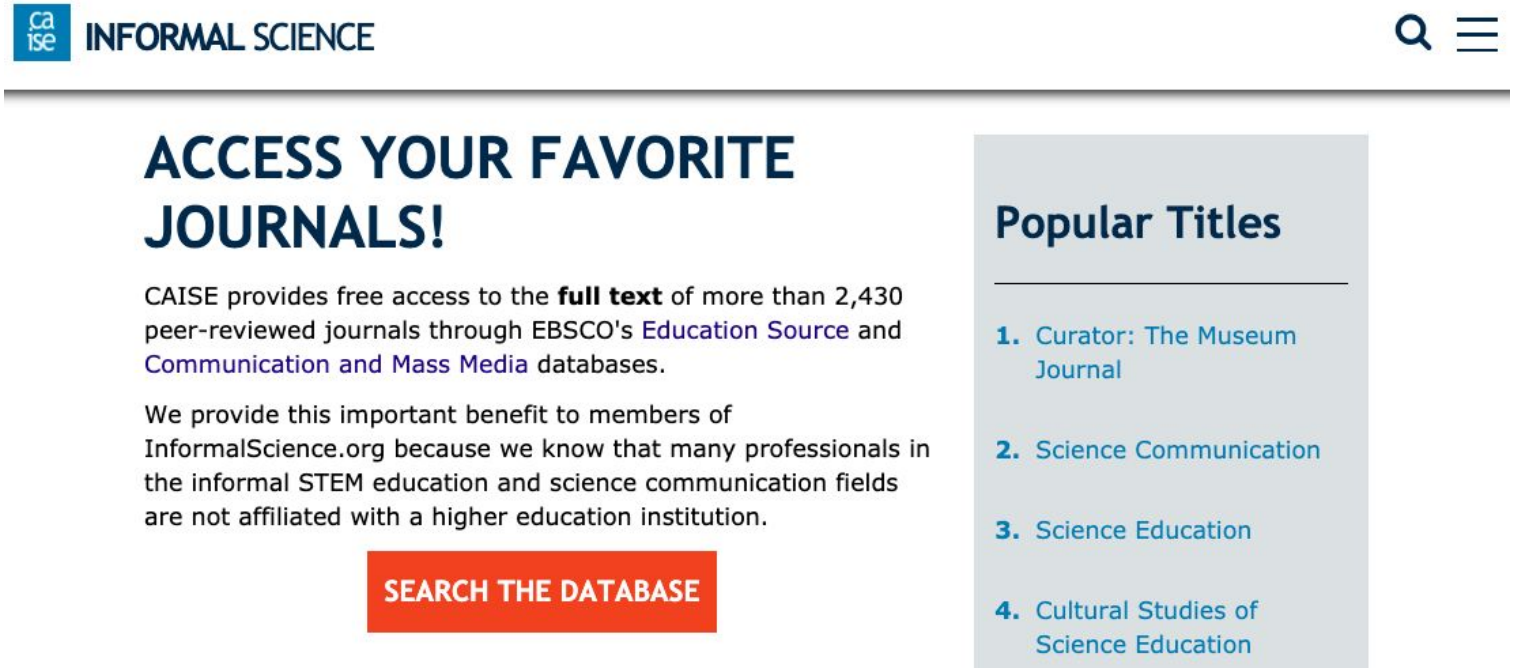
Research papers, syntheses, consensus reports, and compendia

Resources and Notable Moments

Practitioner materials, conferences, and events

Accessing Peer-Reviewed Literature on EBSCO

Some of the resources included in the 2019 *Year in ISE* are behind paywalls. Members of InformalScience.org can access the resources included in this document along with the full text of more than **2,700** peer-reviewed journals through EBSCO's *Education Source* **database** and *Communication Source* **database.** These journals include *Science Communication*, *Curator: The Museum Journal*, *Science Education*, *Cultural Studies of Science Education*, and *Science Scope*. To access, visit this **page**, log in to your account, and begin exploring. The training video **"Tips for Navigating EBSCO"** provides a quick "how to" guide to refine literature searches and save search history.



Sectors and Categories

The sections are listed and linked alphabetically below. These areas of work have emerged over time to reflect the contexts and communities where informal STEM education is developed and implemented.

1. Citizen Science & Public Participation in Scientific Research
2. Cyberlearning & Gaming
3. Living Collections
4. Making & Tinkering
5. Media
6. Public Libraries
7. Public Science Events
8. Science Centers & Museums
9. Science Communication
10. Youth & Afterschool
11. Other Notable Publications & Moments

Highlighting Diversity, Equity, Access and Inclusion

This icon is used throughout this document to highlight resources with a focus on addressing diversity, equity, access and inclusion.

Citizen Science & Public Participation in Scientific Research (PPSR)

Back to the list of sectors

Citizen Science & PPSR

By the Numbers

More than **3,000** projects and events are registered on **SciStarter**, a global repository of citizen science projects, people, tools, and events. Here are the top 10 projects of 2019 that the collective community shared and joined:

Most Shared

- Globe at Night *
- MyCoast
- Darwin's Ark
- Stream Selfie *
- ebird
- AirCasting
- Snow Tweets
- Wicked Hot Boston! Forum by the Museum of Science, Boston
- Iconic wildlife species of Cusco, Peru

Most Joined

- Stall Catchers
- iNaturalist
- Stream Selfie *
- Project Squirrel
- Globe Observer: Clouds
- Phylo
- Never Home Alone @ NCSU
- Ant Picnic
- Globe at Night *
- WaterInsights
- CoCoRaHS: Rain, Hail, Snow Network

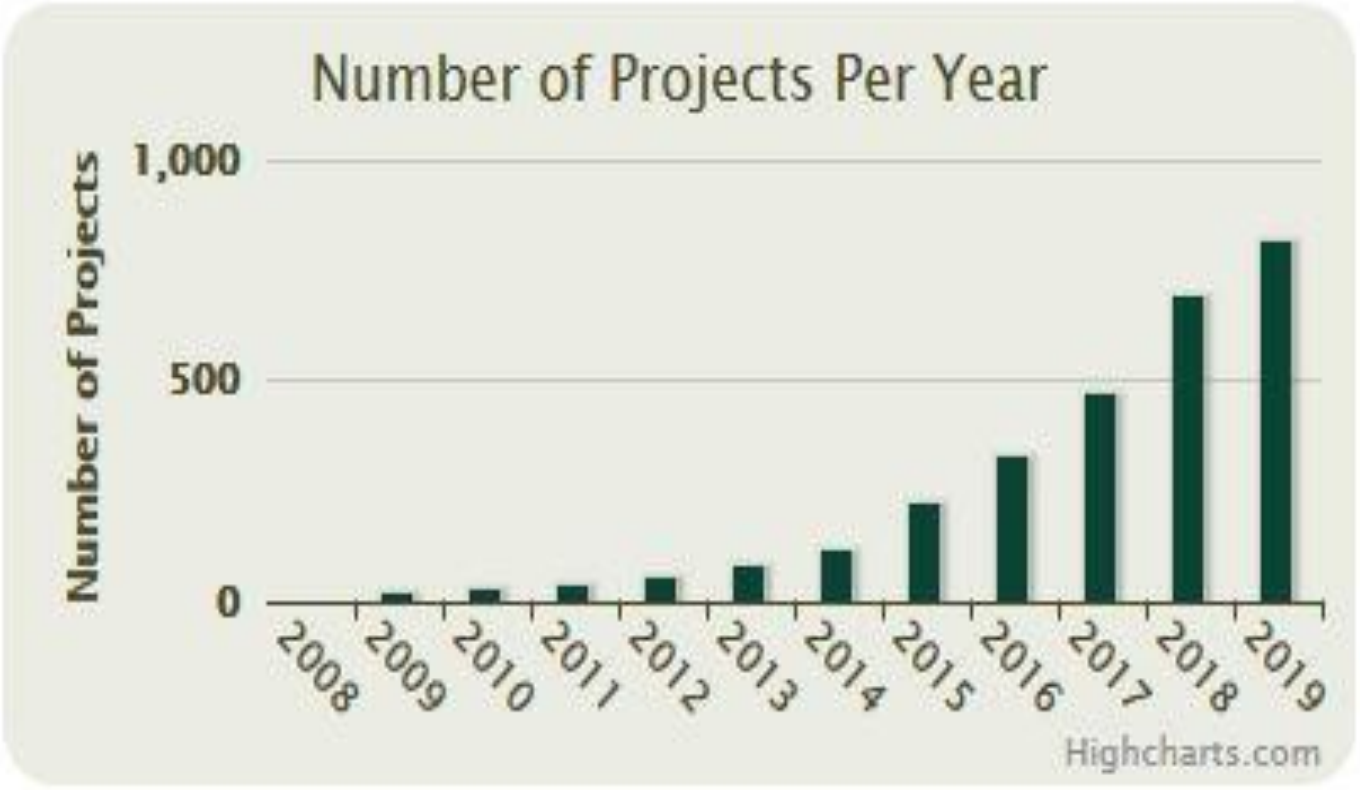
***Projects with stars appear in the top 10 on both lists!**

scistarter®
Science we can do together.

Citizen Science & PPSR

By the Numbers

CitSci.org projects: In 2019, volunteer coordinators started **841 projects** that have contributed a total of **1,078,640 measurements** for analysis to answer local, regional, and/or global questions.



Citizen Science & PPSR

Select Publications

User Experience of Digital Technologies in Citizen Science

Artemis Skarlatidou, Marisa Ponti, James Sprinks, Christian Nold, Muki Haklay, and Eiman Kanjo

This special issue includes seven papers that identify the importance of design standards, design methods, and better understanding of participant experiences in order to create successful projects.

Engagement in Science Through Citizen Science: Moving Beyond Data Collection

Tina Phillips, Heidi Ballard, Bruce Lewenstein, and Rick Bonney

This study describes engagement in citizen science across six environmentally based projects. Citizen science is examined through cognitive, affective, social, behavioral, and motivational factors. A Dimensions of Engagement framework is presented that can support new questions and methodologies for studying engagement in citizen science and other forms of informal science education.

Citizen Science: Theory and Practice: Ethical Issues in Citizen Science

Lisa Rasmussen and Caren Cooper (guest editors)

This special issue explores how citizen science can challenge existing ethical norms because it falls outside customary methods of ensuring that research is conducted ethically. What ethical issues arise when engaging the public in research? How have these issues been addressed, and how should they be addressed in the future?

Toward an International Definition of Citizen Science

Florian Heigl, Barbara Kieslinger, Katharina T. Paul, Julia Uhlik, and Daniel Dörler

This reflective analysis proposes that researchers and participants establish a shared understanding of what citizen science is and what it is not. Articulating the criteria that projects need to fulfill could increase the quality of participatory research opportunities, help the field flourish, and increase recognition and use of citizen science data and results.

Citizen Science & PPSR

Select Publications

Citizen Science: An Information Quality Research Frontier

Roman Lukyanenko, Andrea Wiggins, and Holly K. Rosser

This article provides an analytical overview of publications on citizen science by field, over time, and a list of some notable scientific discoveries.

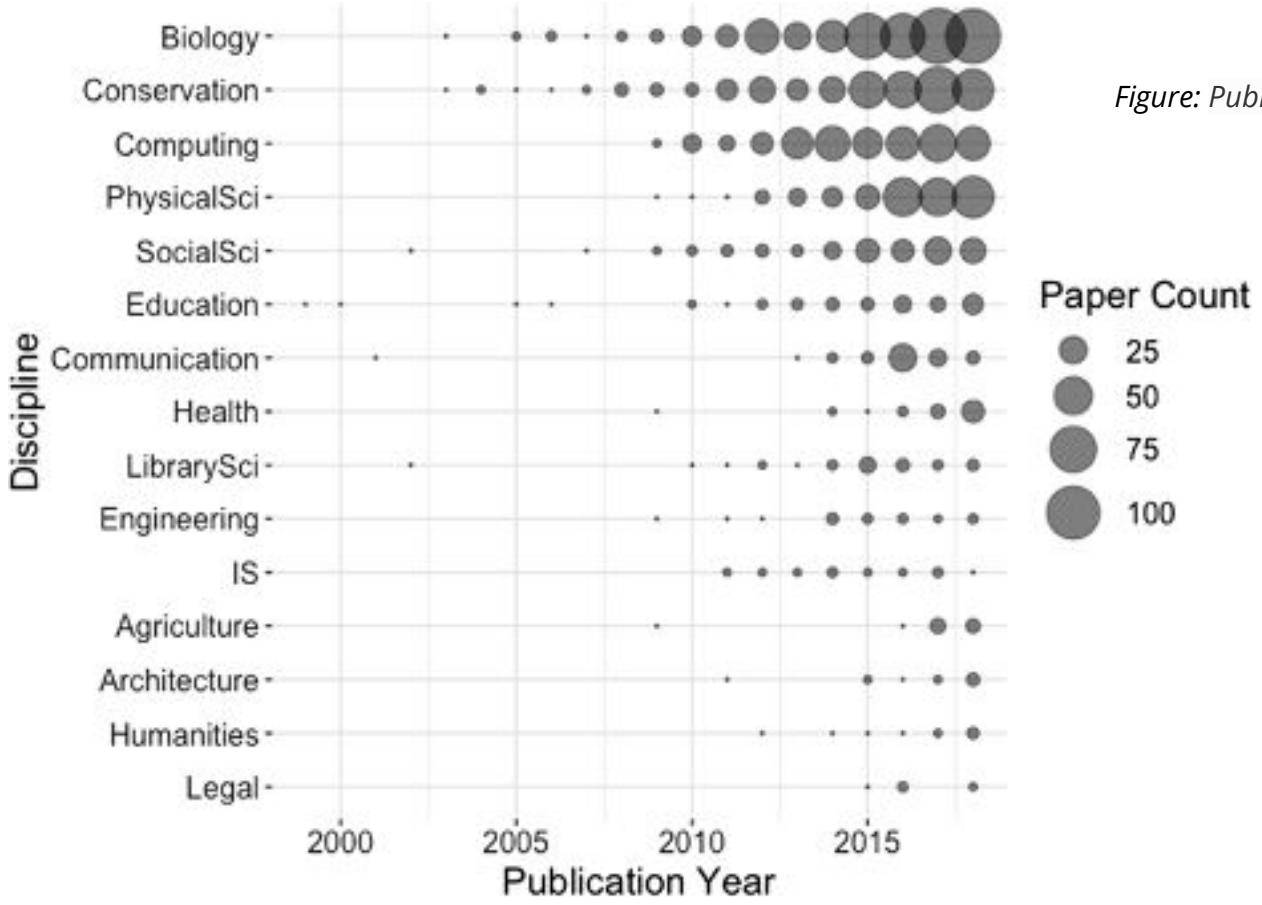


Figure: Publications on citizen science by discipline over time

Citizen Science & PPSR

Resources & Notable Moments

American Spring Live

Fred Kaufman (producer)

In this three-part series, researchers and citizen scientists investigate how a wide range of organisms respond to the change of seasons. During the multi-platform events held live on April 29, April 30, and May 1, 2019, on PBS and Facebook, scientists shared insights into the natural world and revealed new technologies that make discoveries possible.

The Value of Stakeholder Mapping to Enhance Co-creation in Citizen Science Initiatives

Artemis Skarlatidou, Monika Suškevičs, Claudia Göbel, et al.

This report highlights findings from an international two-day stakeholder mapping workshop. An increased understanding of stakeholder mapping for co-created citizen science initiatives may contribute to more effective stakeholder communication, more successful implementation, and a greater impact for citizen science.

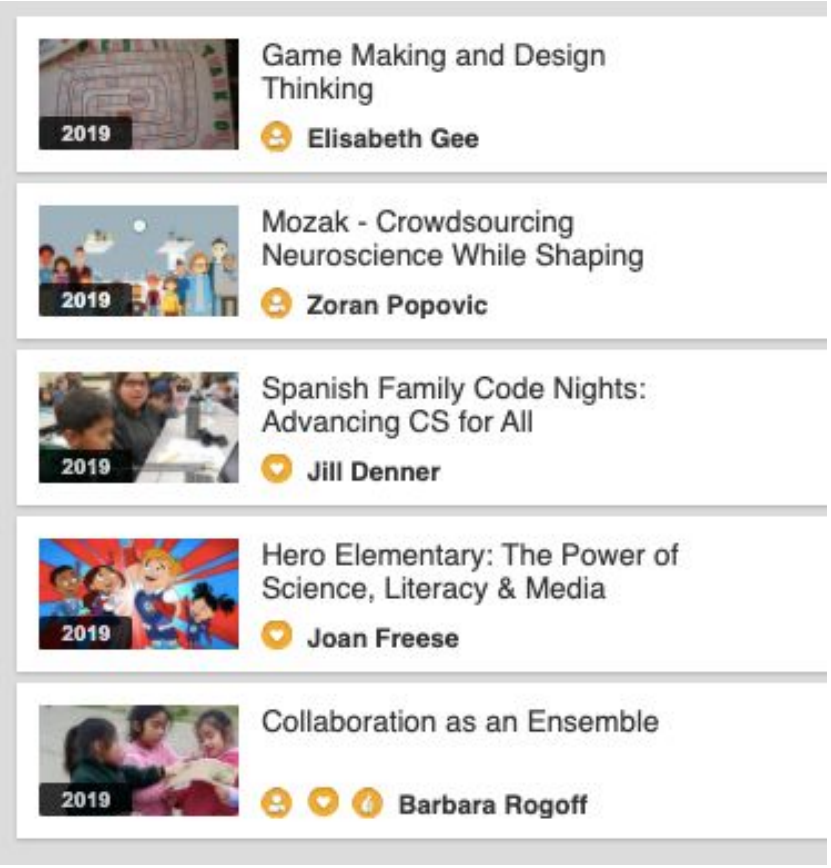
Cyberlearning & Gaming

Back to the list of sectors

Cyberlearning & Gaming

By the Numbers

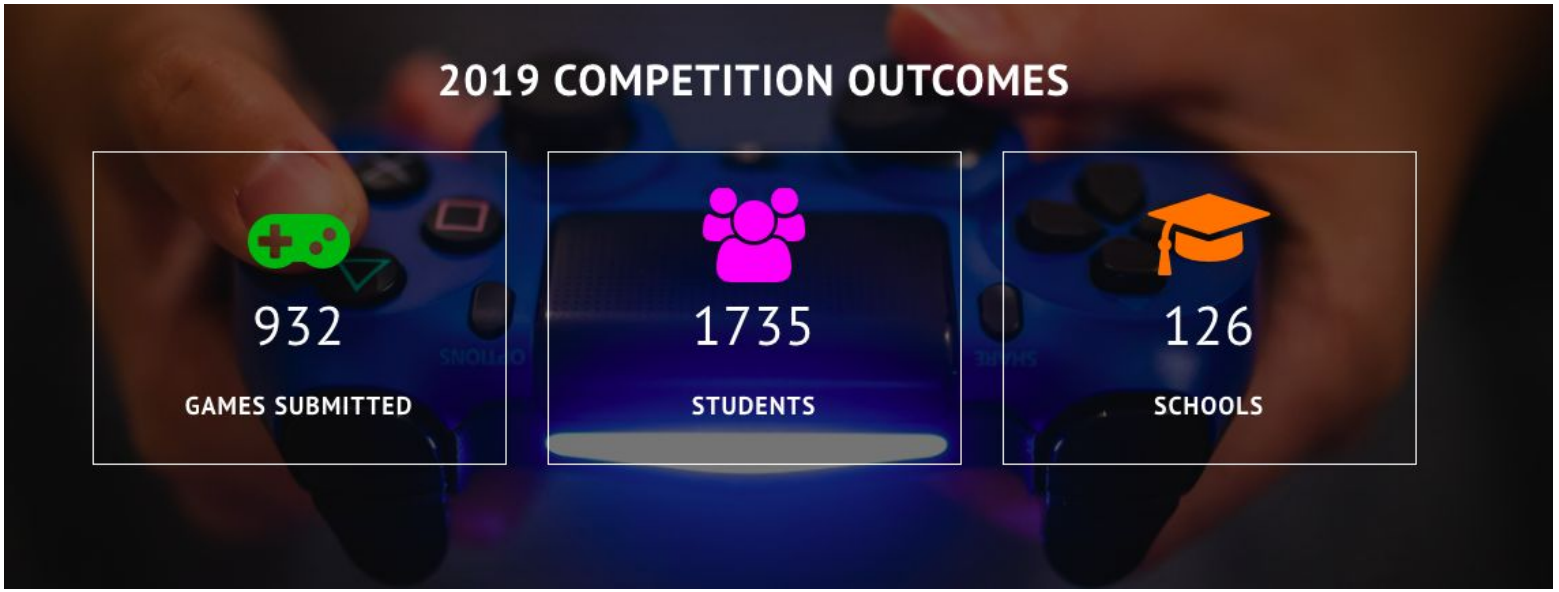
In 2019, **29 project videos** focused on gaming were featured in the STEM for ALL Video Showcase. The viewing community identified the **five** projects listed below as “award winning.”



Cyberlearning & Gaming

By the Numbers

Games for Change (G4C) held the 5th Annual Student Challenge, in which students from New York, Los Angeles, Atlanta, and Detroit implemented an impact game design curriculum in their classrooms and after-school programs. Learn more and explore the award-winning projects from each city.



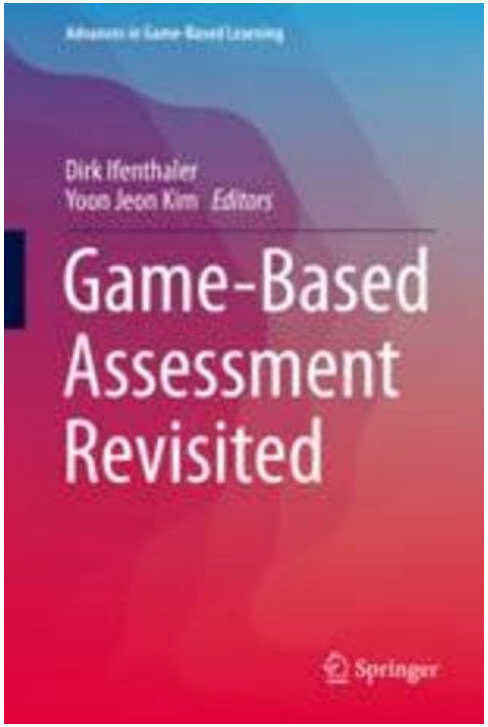
Cyberlearning & Gaming

Select Publications

Game-Based Assessment: The Past Ten Years and Moving Forward

Yoon Jeon Kim and Dirk Ifenthaler (editors)

This chapter provides an analysis of 10 years of game-based assessment and explores what has been learned from methods like external measures, log data capturing in-game actions, and game-related actions beyond the game context. It is part of the *Advances in Game-Based Learning* book series.



The 2019–2024 Global Game-based Learning Market: Serious Games Industry in Boom Phase

Sam S. Adkins

Metaari's report on the serious games industry evaluates eight game-buying segments of the market: preschools, primary, and secondary schools; tertiary and higher education institutions; federal and local government agencies; and corporations. The study includes a detailed analysis for the United States on more than 2,000 companies producing education and training products.

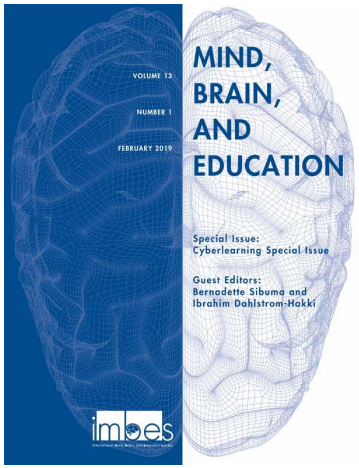
Cyberlearning & Gaming

Select Publications

Mind, Brain, and Education Special Issue on Cyberlearning

Bernadette Sibuma and Ibrahim Dahlstrom-Hakki (editors)

The issue highlights how innovative technologies are transforming learning (including social, emotional, and cognitive aspects of learning) and research in formal and informal education by drawing on cognitive science and educational neuroscience. The issue is available for free download to **InformalScience.org members** via the EBSCO Education Source database.



Innovating Pedagogy 2019

Rebecca Ferguson, Tim Coughlan, Kjetil Egelandsdal, et al.

This report from The Open University highlights key trends in teaching, learning and assessment for an interactive world. It addresses 10 approaches in order of the likely timescale of broad implementation: playful learning, learning with robots, decolonizing learning, drone-based learning, learning through wonder, action learning, virtual studios, place-based learning, making thinking visible, and roots of empathy.

Cyberlearning & Gaming

Select Publications

DE AI

Pursuing the Dream: A 50-Year Perspective on American Society, Technology, and Inclusion in Computing

Freeman A. Hrabowski

This research assesses the way that approaches like course redesign, active and experiential learning, research, and partnerships with companies and agencies promote student success, inclusive excellence, and achievement for all students in STEM generally and for computer science in particular.

DE AI

Electronic Textiles in Computer Science Education: A Synthesis of Efforts to Broaden Participation, Increase Interest, and Deepen Learning

Gayithri Jayathirtha and Yasmin B. Kafai

This paper synthesizes 46 studies that have introduced crafts, circuitry, and coding concepts with e-textiles in K–16 education. The analysis found that e-textiles have been successful in broadening participation and increasing interest in computing for many youth and adults, especially from underrepresented groups, inside and outside of school.

Cyberlearning & Gaming

Resources & Notable Moments

50th ACM Technical Symposium on Computer Science Education (SIGCSE '19)

Minneapolis, MN, USA, February 2019

Proceedings highlighted research, evaluation, and critical reflections on the position of computer science education in the context of STEM engagement and achievement.

The International Conference on Computer Supported Collaborative Learning (CSCL)

Lyon, France, June 2019

The conference theme ***A Wide Lens: Combining Embodied, Enactive, Extended, and Embedded Learning in Collaborative Settings*** included sessions that featured some combination of embodied, enactive, extended, and embedded **(4E)** learning. Highlighted research addressed the complex relationships in learning processes between social, emotional, cultural, linguistic, cognitive, and technological factors.

Living Collections

Zoos, aquariums, botanical gardens, parks, and nature centers

Back to the list of sectors

Living Collections

By the Numbers

The Association of Zoos and Aquariums (AZA) 2019 annual member survey revealed:

238
Accredited Zoos & Aquariums

100
Years

800,000
Animals

1,000 threatened or endangered species in AZA-accredited zoos & aquariums

12m
Students

198,000
Jobs

200,000,000
Visits a Year

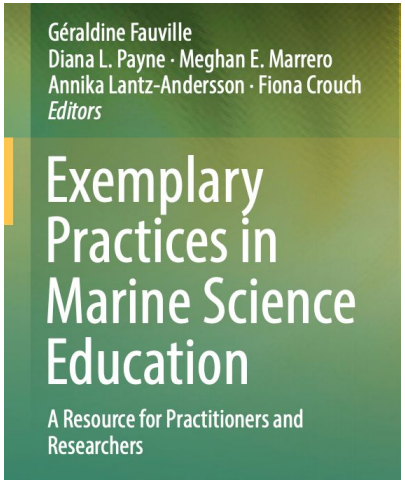
Living Collections

Select Publications

Effective Practices for Fostering Empathy Towards Marine Life

Jim Wharton, Kathayoon Khalil, Catie Fyfe, and Ashley Young

This chapter presents the construct of empathy and its components, discusses empathy's relationship to behavior change, and offers six research-validated practices for developing empathy.



Lions, Tigers, and Teens: Promoting Interest in Science as a Career Path Through Teen Volunteering

Leah Cuddeback, Jenn Idema, and Kristy Daniel

This article describes the positive impact of the Saint Louis Zoo's teen volunteer program, Zoo ALIVE, on participants' views of science, science careers, and environmental awareness.

Living Collections

Resources & Notable Moments

DE AI

The American Public Gardens Association 2019 annual meeting theme was ***Thrive Together: Diversity Grows Gardens*****.** Seven sessions across conference tracks highlighted the importance of centering equity in the design, development, and implementation of public programming.

Living Collections

Resources & Notable Moments

DE AI

iSWOOP (Interpreters and Scientists Working on Our Parks) is a project in which the National Park Service works to enhance the impact of interpreter–visitor interactions on STEM learning. Program evaluation found that most visitor groups lacked diversity. To address this finding a meeting was convened to explore how to best engage communities of color in equitable partnerships with park staff. This summary blog provides a reflection on the event that brought together park rangers from Indiana Dunes National Park and 16 environmentalists and educators of color from northwest Indiana and Chicago.

The Why Zoos and Aquariums Matter 3 (WZAM³) project conducted two webinars with CAISE in 2019. The first webinar described how WZAM³ conceptualizes the visit as a four-part experience in order to better understand the role and impact of zoos and aquariums across a person's lifetime. The second webinar presented preliminary findings from a survey of visitors across 25 zoos and aquariums exploring what visitors bring to, do during, and take from their visit, as well as how the public's perceptions of and trust in zoos and aquariums are shaped by words and context.

Making & Tinkering

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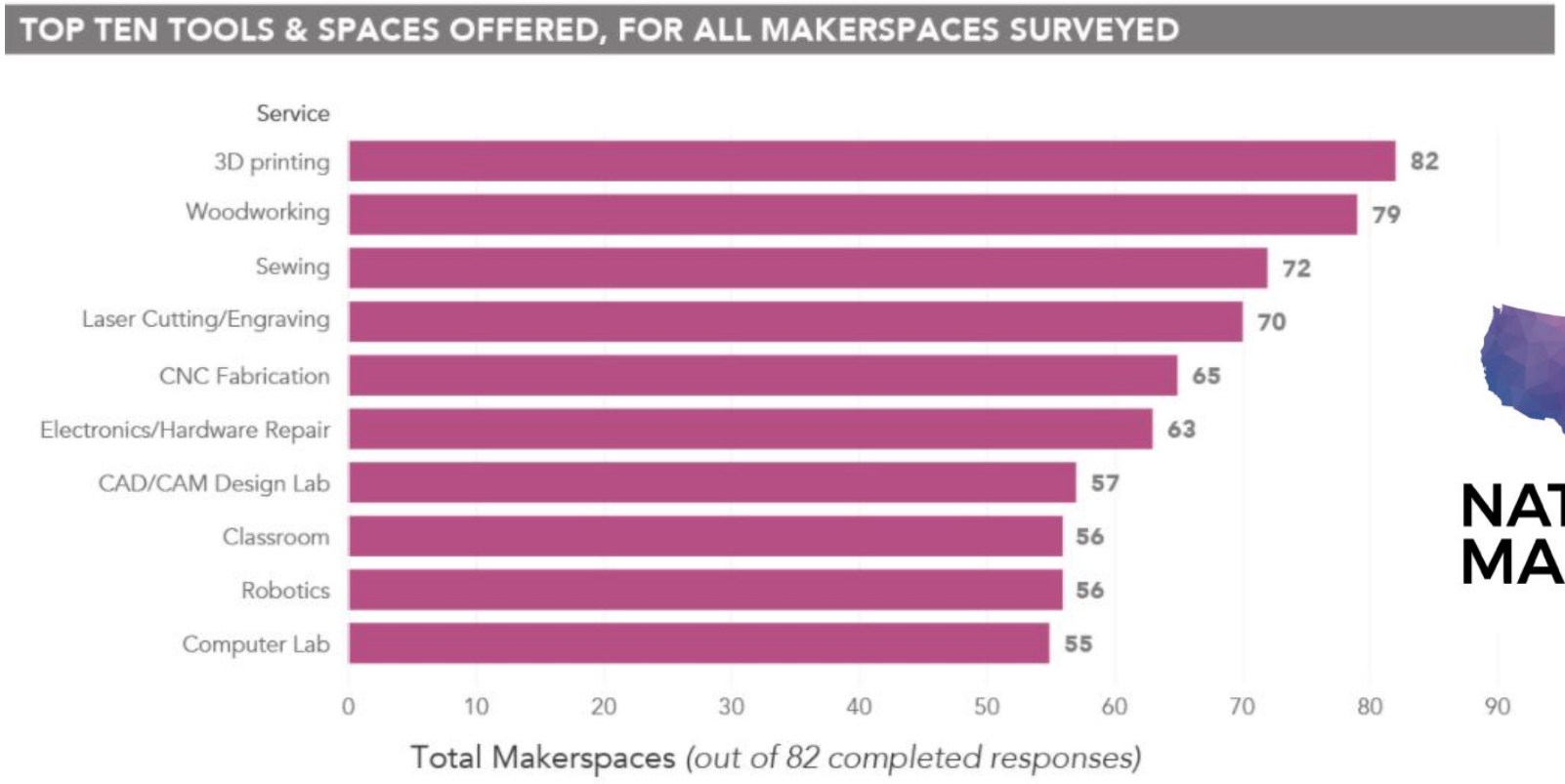
Making & Tinkering

By the Numbers

The **Nation of Makers** is an organization committed to encouraging connections, broadly sharing resources, facilitating funding opportunities, engaging in policy development, and advocating for the maker movement. In 2019, the **makethedata** initiative began to publish blogs sharing insights from the 2018 national survey of makerspaces. The figure below is from the post **"Let's Talk Tools"** that explores the distribution of tools and spaces that are offered in makerspaces.



NATION OF MAKERS

Making & Tinkering

Select Publications

DE AI

Engineering for Sustainable Communities: Epistemic Tools in Support of Equitable and Consequential Middle School Engineering

Edna Tan, Angela Calabrese Barton, and Aerin Benavides

This study focused on engineering for sustainable communities using three in-depth case studies that explore how community engineering and ethnography tools for defining problems—as well as integrating perspectives in design through iterative design sketch-up and prototyping—work to support engagement and increase equitable learning opportunities.

Where Should Learners Struggle? Developing a Failure Mindset Through Maker Activities

Alice Anderson, Megan Goeke, Amber M. Simpson, and Adam V. Maltese

This article explores how activity design and learning contexts can influence youth failure mindsets. Youth descriptions of failure-positive and failure-negative experiences offer a unique opportunity to identify how experiences can be designed to support learning and persistence.

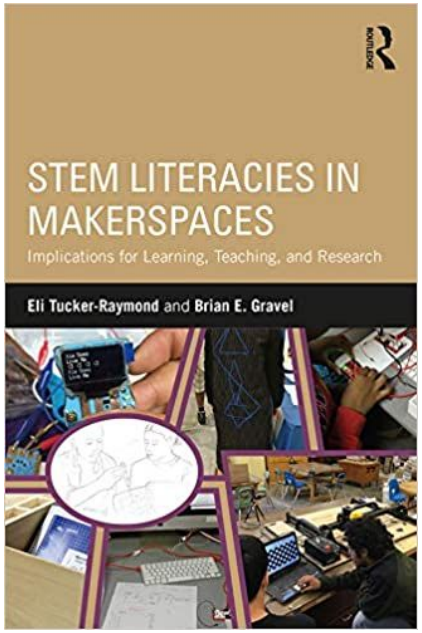
Making & Tinkering

Select Publications

STEM Literacies in Makerspaces: Implications for Learning, Teaching, and Research

Eli Tucker Raymond and Brian E. Gravel

This book provides a framework for investigating how STEM can be learned and practiced in makerspaces. The authors' three-year study of making in different contexts is based in literacy studies and STEM scholarship. Observations of two adult making spaces, a community-based youth making program, and a high school are coupled with interviews to provide rich vignettes of STEM literacies and critically examine underrepresentation, equity, and access in these spaces.



Conversational Reflections About Tinkering Experiences in a Children's Museum

Lauren C. Pagano, Catherine A. Haden, David H. Uttal, and Tsivia Cohen

This study explored the conditions of tinkering and conversational reflection that can enhance STEM learning opportunities for young children. Analysis revealed that families who took their tinkering creations with them when they left an exhibit talked the most about engineering and the value of tinkering, and those who participated in the design challenge talked the most about engineering practices and least about tools.

Making & Tinkering

Resources & Notable Moments

DE
AI

The [FABLEARN 2019] conference theme was "**What Role Does Maker Education Play in a World with Growing Social and Environmental Challenges?"** 2019 saw the largest number of total submissions (227), registered conference attendees (~420), and countries represented (23). There was a renewed commitment across meeting sessions to highlight opportunities for making to enable educators and youth to co-invent new activities and technologies. Engineers and designers are also working to increase access to inaccessible systems to promote inclusion and diversity. Explore the **playlist** of recorded sessions to learn more about the work of this community.

Making & Tinkering

Resources & Notable Moments

DE
AI

[126th American Society for Engineering Education Annual Conference and Exposition (ASEE '19)]

Tampa, FL, USA, June 2019

Proceedings highlighted research, evaluation and pedagogical approaches for engineering education spanning preschool through professional practice in school and out-of-school settings. Several papers in the proceedings focus on making, tinkering, and engineering design, with others focused on promoting diversity, equity and inclusion in engineering education. Papers from the 2019 and previous conferences can be found in the **[ASEE Papers on Engineering Education Repository (PEER).]**

Media

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Media

By the Numbers

Through **summits**, awards, fellowships, and showcases, **Jackson Wild™** highlights how media can inspire wonder and encourage action to restore and protect the planet through high-impact collaboration.

Media Awards Winners

There were **900** category entries and almost 600 film entries overall in the 2019 Jackson Wild film competition—the largest yet. Preliminary judges screened **3,500** hours of film to determine the 2019 finalists.

Legacy Award Winner

Paul Hawken won the 2019 Legacy Award and was the **keynote** interviewee. He is the founder of Project Drawdown, which works with scholars, students, scientists, researchers, and activists to map, measure, and model the 100 most substantive solutions that can cumulatively reverse global warming by reducing and sequestering greenhouse gases.

Media

Select Publications

DE
AI

Young Adults' News Behaviors and Beliefs

John S. and James L. Knight Foundation

This report examined trust in media, showing that many young adults use news media to make decisions on policies and voting. It revealed that a majority of young adults are concerned about the impact of news on democracy and unity in the country, expressing fears that news organizations might divide and polarize citizens. Conducted by NORC at the University of Chicago, the report analyzed the findings of a survey of 1,660 adults between the ages of 18 and 34. It also surveyed large samples of African American and Hispanic participants to explore beliefs and behaviors across races and ethnicities.

DE
AI

STEM Student Reporting Labs: Youth Engagement Through Journalism

Jena Barchas-Lichtenstein, John Fraser, John Voiklis, Uduak Grace Thomas, and Kate Flinner

Knology's four year evaluation of the PBS NewsHour's STEM Student Reporting Labs (SRL) initiative found that youth who participated in the program demonstrated increased media literacy, stronger critical thinking skills, and capacity to recognize connections between academic concepts and real world situations. In addition, STEM SRL experiences increased youth awareness of pathways for traditionally underserved individuals to pursue STEM and STEM adjacent careers.

Media

Select Publications

DE AI

Radio & Audio Grantmaking: Reaching New Audiences Through Old Platforms

Sarah Armour-Jones

Both radio and audio are being used in exciting ways to reach new audiences, spark civic engagement and dialogue across diverse communities, examine science, advance disability education, and much more. Radio, in particular, receives a significant share of philanthropic funding when compared to television and film and video.

DE AI

The State of Social Impact Entertainment

Skoll Center for Social Impact Entertainment

Social impact entertainment is changing the world. This landmark report explores the emerging field through the views and insight of the artists and industry experts who know it best.

Media

Apollo 50: Go for the Moon

The Smithsonian's National Air and Space Museum presented a once-in-a-lifetime celebration of the 50th anniversary of Apollo 11. For three nights in July 2019, visitors to the National Mall could view the 17-minute experience created by 59 Productions: a full-motion projection-mapping artwork on the Washington Monument, along with archival footage on screens, to recreate the launch of Apollo 11 and tell the story of the first moon landing.

Media

Resources & Notable Moments

The Crowd & The Cloud is a four-part public television series that explored the potential and challenges of citizen science projects. Each episode took viewers on a global tour of the projects and people on the front lines of this disruptive transformation in how science is done, and showed how anyone, anywhere, can participate. Episodes were available in 2019 through streaming services and on PBS channels.

Public Libraries

Back to the list of sectors

Public Libraries

By the Numbers

The Institute of Museum and Library Services (IMLS)

Accelerating Promising Practices for Small Libraries

This initiative was created to support projects that strengthen small and/or rural libraries and archives to better serve their communities by transforming school library practice, enhancing community memory, and addressing digital inclusion.

- **30 libraries** received grants through this program across **21** states and Puerto Rico.

National Leadership Grants for Libraries

These awards support projects that advance theory and practice by generating new tools, research findings, models, services, practices, or alliances that will be widely used, adapted, scaled, or replicated to enhance the impact of libraries and archives. There were three project categories: Lifelong Learning, Community Catalysts, and National Digital Infrastructures and Initiatives.

- There were **36 libraries** who received grants through this program
  - **7 Lifelong Learning**
  - **10 Community Catalysts**
  - **18 National Digital Infrastructures and Initiatives**

INSTITUTE of Museum and Library SERVICES

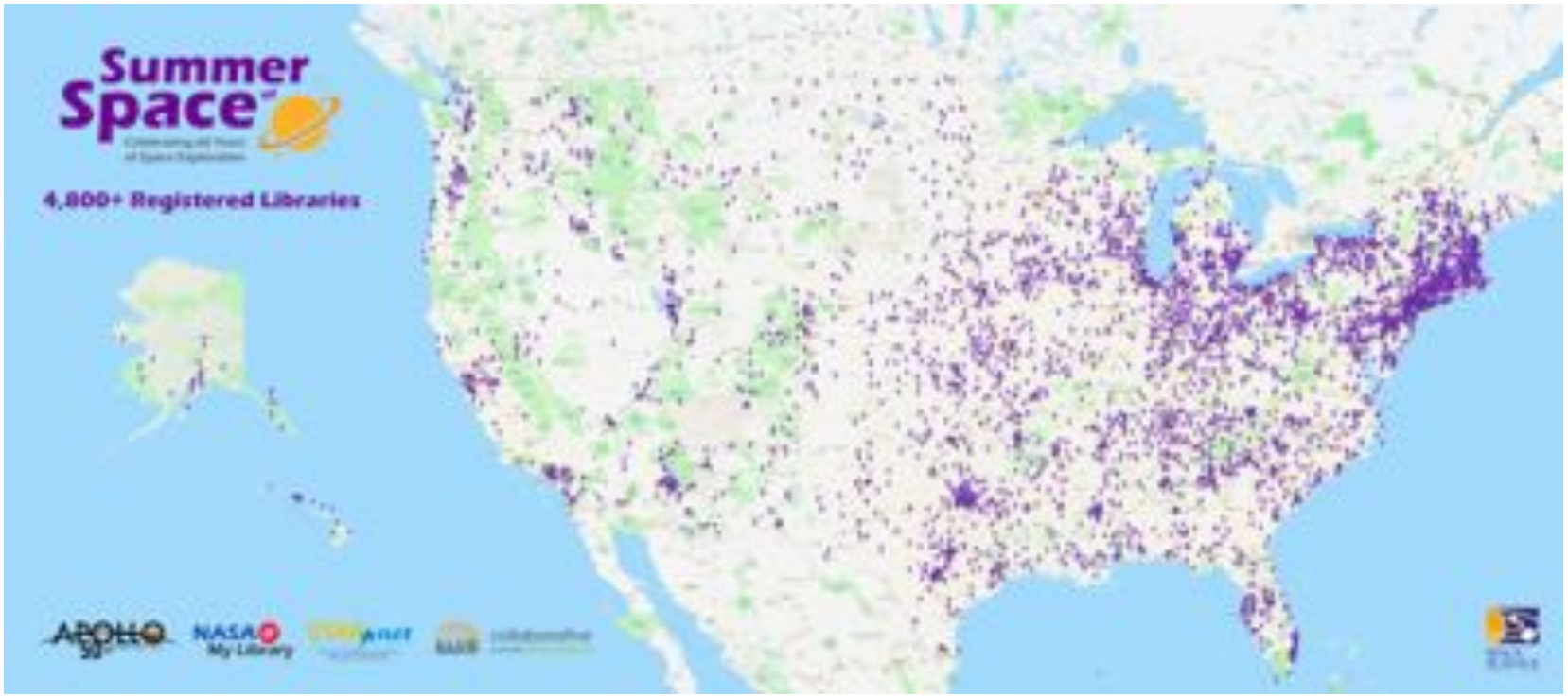
IMLS Annual Public Libraries Survey

This is a census survey that collects data from the entire population of US libraries. Survey results from FY 2017 were published in 2019. The survey covered **9,216 public libraries,** as identified by state library administrative agencies.

Public Libraries

By the Numbers

[Summer of Space/ Universe of Stories] succeeded in supporting: **38,400** programs, reaching **768,000** participants, engaging with **7,350** subject matter experts, and distributing **1,300** NASA lunar tactile books and **400** space themed scholastic books.



The 2019 Summer of Space Stories event hosted by [STAR Net] in partnership with the Collaborative Summer Library Program was successful in providing resources, contacts, and activities to over **4,800** libraries across the **ALL 50 states.** This event coincided with the celebration of the 50th anniversary of the Apollo 11 Moon Landing and NASA's 60th anniversary.

Public Libraries

Select Publications

DEAI

Community Relationships to Build Family Access to STEM Learning. Global Family Research Project

Keliann LaConte, Anne Holland, Lisa Lewis, and Michelle Ross

The STAR Library Network team shares tips and ideas for using community dialogues to raise up family and community voice and build partnerships in designing STEM-related library services.

DEAI

Community STEM Collaborations that Support Children and Families

Dan Gilbert and Leah Silverberg, Keliann LaConte Anne Holland, Margaret Caspe, Rachel Hanebutt

In this resource guide, the authors reflected on their collaboration and lessons learned about partnership among families, librarians, and afterschool providers across the nation around the importance of STEM learning.

Public LIbraries Engage Families in STEM

M. Elena Lopez, Linda Jacobson, Margaret Caspe, and Rachel Hanebutt

This brief examined how public libraries, with federal and state support, are creating STEM learning that brings together children and families across the K–12 years.

Exploring "STEM-Readiness" in Public Libraries

Annette Shtivelband, Kimberly S. Spahr, Robert Jakubowski, Keliann LaConte, and Anne Holland

This study examined "STEM-readiness" through the lens of Diffusion of Innovations Theory. Results indicated that most libraries are ready to implement STEM programing. Public libraries that have access to resources are more likely to be STEM-ready, whereas those with fewer resources may need additional support.

Public Libraries

Resources & Notable Moments

DE
AI

American Library Association

The 2019 Annual meeting brought together up to 25,000 librarians and library staff, educators, authors, publishers, friends of libraries, trustees, special guests, and exhibitors to network while they engaged and participated in the ongoing transformation of libraries. Over the six-day event, there were **174 offerings** that focused on equity diversity and inclusion. There were also a number of sessions focused on making and tinkering situated in library

ALA ANNUAL CONFERENCE & EXHIBITION | JUNE 20–25, 2019 WASHINGTON, D.C.

The Librarian's Guide to Citizen Science

D. Cavalier, C. Nickerson, R. Salthouse, and D. Stanton (editors)

This guide was created to help librarians access resources, learn about projects and programs, and navigate the growing range of opportunities to bring citizen science to library settings.

Public Science Events

Back to the list of sectors

Public Science Events

By the Numbers

DEAI

New, Not Different: Data-Driven Perspectives on Science Festival Audiences

Katherine Neilsen, M.J. Gathings, and Karen Peterman

This commentary explored the kinds of audiences who attend science festivals in the United States by examining data from nearly **10,000** attendees at **24** festivals. Findings suggest that approximately two-thirds of festival-goers are new each year.

DEAI

Science Festival Alliance Annual Report

Julie Fooshee

This report provided a snapshot of Science Festival Alliance activity in 2018 based on voluntary self-reporting. Published in 2019, The report highlights the ways in which the co-creation of learning experiences at festivals reflect the communities in which they occur.

Public Science Events

Select Publications

DE AI

"Going to These Events Truly Opens Your Eyes". Perceptions of Science and Science Careers Following a Family Visit to a Science Festival

Cherry Canovan

Young people's decisions to study science are strongly influenced by the attitude of their parents. This study asked whether family attendance at a science festival could shift perceptions that science is "narrow" and "not for us." Findings suggested that parents from underserved areas were significantly more likely to feel increased positivity about their children pursuing science careers. Participants also reported learning about the breadth of careers in science.

Does the Messenger Matter? Studying the Impacts of Scientists and Engineers Interacting with Public Audiences at Science Festival Events

Todd Boyette and Jefferson Ramsey

This paper reported on the 5,498 surveys collected from attendees at 14 science expos around the United States. Respondents who interacted with a scientist rated their experiences more positively than those who reported no such interaction on five categories: overall experience, learning, inspiration, fun, and awareness of STEM careers. The results indicated that scientists can positively affect audience perception of their experience at these large-scale public events.

Public Science Events

Select Publications

DE
AI

Guerilla Science: Mixing Science with Art, Music and Play in Unusual Settings

Mark Rosin, Jen Wong, Kari O'Connell, Martin Storksdieck, and Brianna Keys

This pre-publication paper presented "Guerilla Science" as one model that supports the hypothesis that well-designed science + art (STEAM) programming in informal settings can broaden participation in and facilitate engagement with STEM-related topics.

The Main Course Was Mealworms: The Epistemics of Art and Science in Public Engagement

Bronwyn Bevan, Jen Wong, Sam Mejias, and Mark Rosin

This paper described an emerging analytical approach to designing and studying STEAM programs that focuses on how programs integrate epistemic practices—the ways in which knowledge is constructed—of science and art.

Figure 8. Mealworms with goat cheese, sun-dried tomato, and fresh herbs © Marina McClure

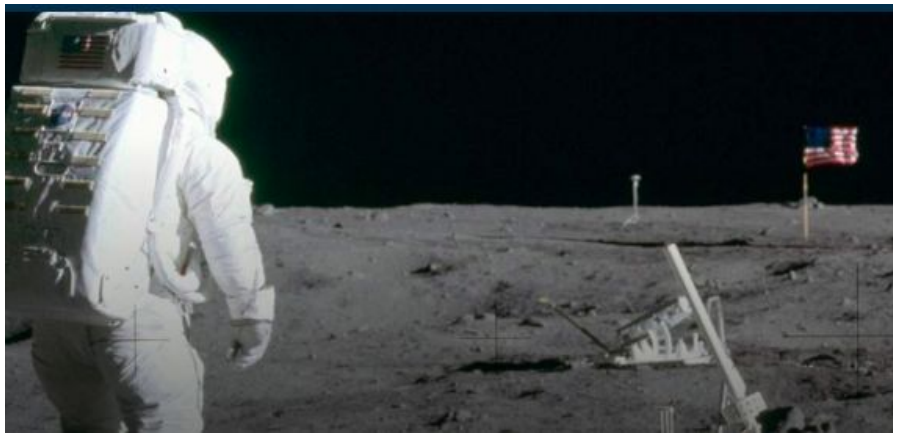
Public Science Events

Resources & Notable Moments

Apollo 50 Festival

The National Air and Space Museum and NASA created the Apollo 50 Festival on the National Mall in July 2019. This outdoor celebration of the first Moon landing featured a full-stage line-up and 20 tented displays that included:

- Hands-on exhibits and activities from exhibitors like NASA, Boeing, Raytheon, The LEGO Group, and PBS's **Ready Jet Go!**
- Live performances on stage by Ready, Jet, Go! featuring costumed characters
- Exciting speakers including Adam Savage, NASA scientists, and museum experts



Science Centers & Museums

Back to the list of sectors

Science Centers & Museums

By the Numbers

In 2019, **13 project videos** conducted in science centers or museums were featured in the **STEM for ALL Video Showcase.** Projects, like those highlighted below, illustrate the range of learning opportunities that are available in these settings.

STEM Pillars: Bringing science to rural libraries & museums

Heather Zimmerman

NYSCI Neighbors Science Ambassadors Program

Andres Henriquez

Signing Glossaries for Science Exhibits

Judy Vesel

2019 STEM FOR ALL VIDEO SHOWCASE
Innovations in STEM Education, May 13-20

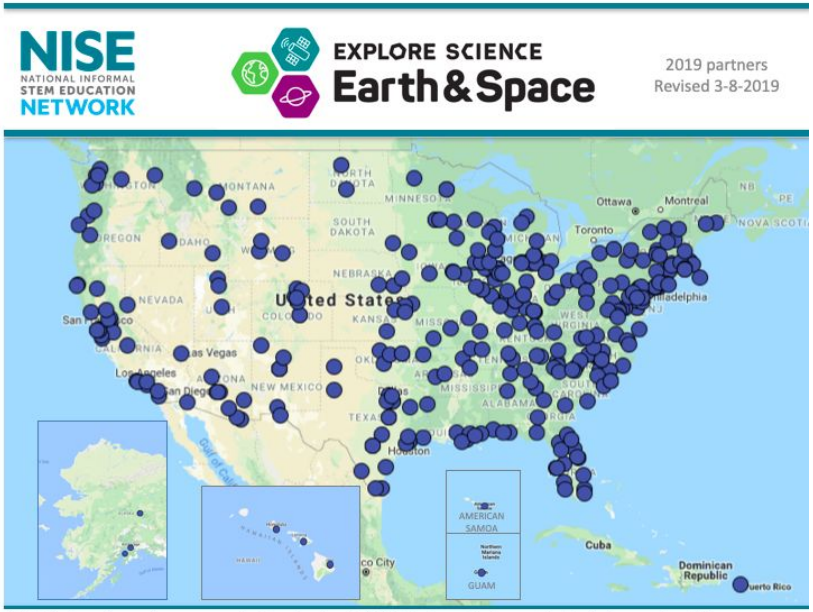
Science Centers & Museums

By the Numbers

NISE Network project Space and Earth Informal STEM Education
This project is focused on raising the capacity of museums and informal science educators to engage the public in astrophysics, earth science, heliophysics, and planetary science, as well as their social dimensions

- In 2019 the project expanded to include **350** ISE organizations who received Explore Science: Earth and Space hands-on activity toolkits. Partner organizations are located in all **50** states and several U.S. territories.
- **Summative evaluation** of the toolkits was designed to document the number and range of audiences reached by the project, the quality of visitor engagement, science identity, and their understanding around NASA's Science Mission Directorate content areas (astrophysics, earth science, heliophysics, and planetary science).

Explore Science: Earth & Space 2019 toolkit recipients



NISE Network partners awarded a physical 2019 Explore Science: Earth & Space toolkit.

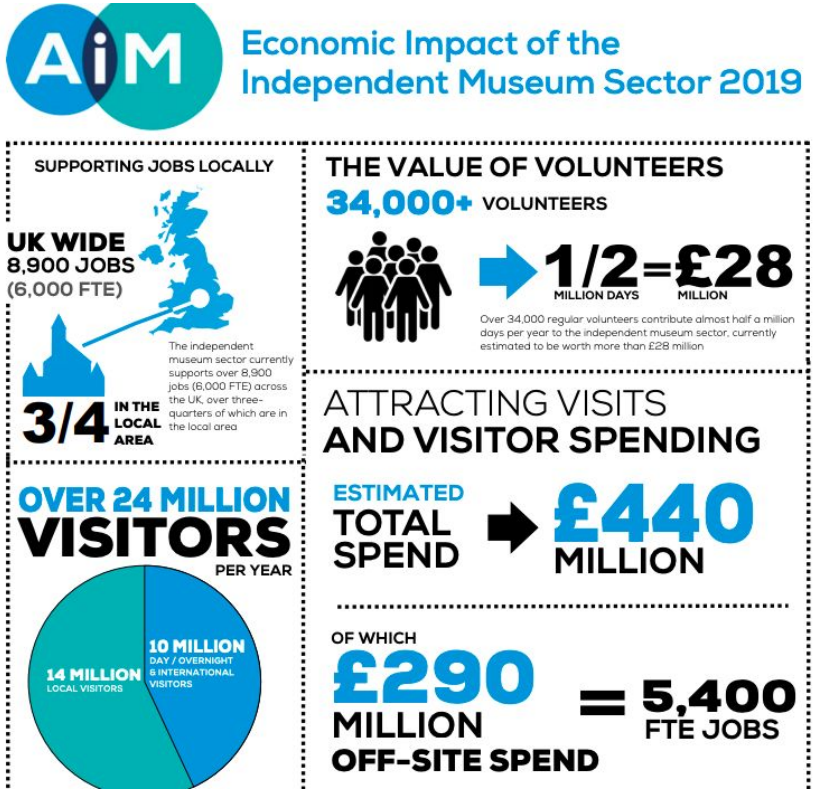
Science Centers & Museums

By the Numbers

Economic Impact of the Independent Museum Sector Summary Report

DC Research and Durnin Research (commissioned by Association of Independent Museums)
This 2019 report analyzed the economic contribution of the independent museum sector in the UK.

- Total direct employment in the independent museum sector is estimated at more than **8,900** jobs. This equates to more than **6,000** full-time equivalent direct jobs.
- More than three-quarters of these jobs are in the local areas where the independent museums are located—showing the significant direct local employment impacts of independent museums.
- As many as **30%** of independent museums do not have any paid staff.
- There are over **34,000** regular volunteers, contributing almost half a million days per year to independent museums.



Science Centers & Museums

Select Publications

Findings and Implications of the Children's Museum Research Network

Nicole Rivera, Stephen Ashton, Robin Meisner, Kari Nelson, Susan Foutz, and Alix Tonsgard

This presentation summarized the work of the children's museum research network. It described the context and creation of the network as well as the process that guided four primary research studies. The graphic to the right highlights key findings from this body of work presented at the Association of Children's Museums Interactivity 2019 conference.

Leveraging Research on Informal Learning to Inform Policy on Promoting Early STEM

Michelle A. Hurst, Naomi Polinsky, Catherine A. Haden, Susan C. Levine, and David H. Uttal

This selective review of the literature on informal STEM learning illustrated how these educational experiences increase early STEM learning. Leveraging cognitive and learning science research, the authors made recommendations in order to advance the impact of informal STEM learning in early childhood education.

Science Centers & Museums

Select Publications

DE AI

The BEST Partnership Program: Supporting Students with ASD by Connecting Schools, Museums, and Occupational Therapy Practitioners

Katie Slivensky, Ellen Cohn, Alexander Lussenhop, and Christina Moscat

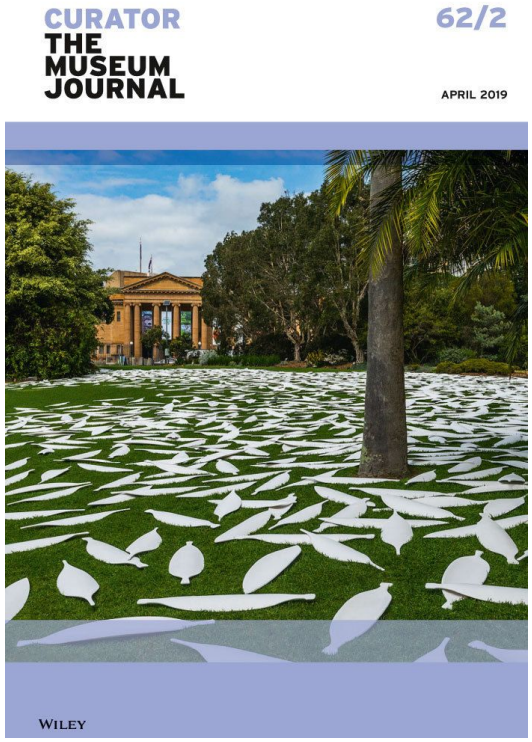
This article described the Buddies Exploring Science Together (BEST) Program, a collaboration between the Museum of Science in Boston, the occupational therapy program faculty and graduate students at Boston University's Sargent College, and Boston Public Schools. The program aims to increase student interest in science and provide opportunities for students with ASD to socially participate in a community setting.

DE AI

Storytelling, Science, and Religion: Promoting Reflection and Conversation about Societal Issues

Rae Ostman, Michael L. Zirulnik, and Jenny McCullough Cosgrove

This paper contextualized the Science & Religion project in the movement to address societal issues in museums, described some of the design and delivery strategies used to create public programs that were inclusive of diverse points of view, reported the programs' impact on participants, and offered lessons learned for museum practitioners who are interested in similar programmatic approaches or topics. Free for download via EBSCO database through InformalScience.org **members**.



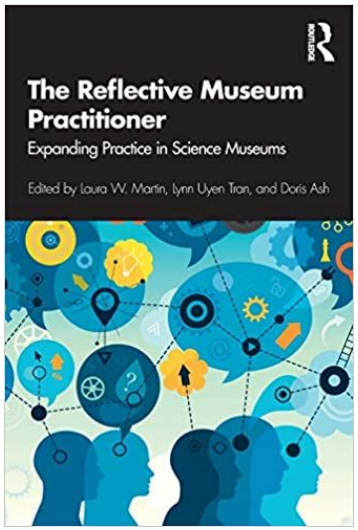
Science Centers & Museums

Select Publications

The Reflective Museum Practitioner: Expanding Practice in Science Museums

Laura W. Martin, Lynn Uyen Tran, and Doris Ash

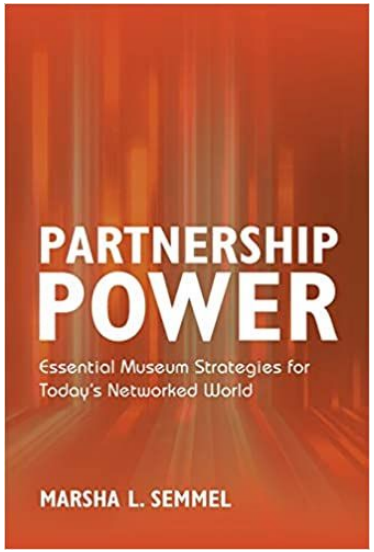
This book explored how the concept of "reflective practice" has been applied in the informal STEM learning environments of museums and zoos. The contributors examined six projects and considered how it encouraged and sustained reflection. Collectively, they raised key questions about changing communities of practice in informal science learning institutions and used a cultural–historical activity theory framework for understanding how changes in museum practice unfold in an institutional context. This **blog post** by Laura Martin provides additional insights into the content of this volume.



Partnership Power: Essential Museum Strategies for Today's Networked World

Marsha Semmel (editor)

This volume identified the characteristics of sustainable and relevant collaborations, within communities, states, and nationally, with examples of broader multi-institutional networks that are increasingly important to maintain relevance in today's hyper-connected world. The book also looked *inside* the museum and considered how institutional culture, staff skills and competencies, financial resources, marketing and working with boards influence the development and maintenance of partnerships. This **blog post** by Paul Orselli provides additional insights into the content of this volume.



Science Centers & Museums

Resources & Notable Moments

Hall of Fossils – Deep Time

After a five-year renovation, the Smithsonian's National Museum of Natural History reopened its Hall of Fossils in June 2019 and was visited by over 40,000 people on opening weekend. The renovation transformed the space from a dimly lit hall of large skeletons and plaster casts in static poses to a brighter series of rooms filled with fossils in dynamic poses mimicking actions they might have taken in life.

Fossil hall at the National Museum of Natural History in 2003. (John Steiner/Smithsonian)

Fossil hall after the renovation.

Science Centers & Museums

Resources & Notable Moments

DE AI

There Are More Male than Female Specimens in Natural History Collections

Natalie Cooper, Alexander L. Bond, Joshua L. Davis (et. al.)

This study explored the sex bias in natural history collections and found that among birds and mammals, males are more frequently collected. The work reflects a growing awareness across all areas of science of underlying sex biases in data and their repercussions in the wider world.

Females are often underrepresented in natural history collections, such as in this group of antelopes. © The Trustees of the Natural History Museum, London

DE AI

Museums as a Pink-Collar Profession: The Consequences and How to Address Them

The Gender Equity in Museums Movement (GEMM)

This report suggested that in a decade women will likely constitute 70% of the national museum workforce. Given the overwhelming majority of women currently enrolled in museum studies graduate programs, as well as the field's junior ranks, a scenario in which women constitute a majority of the workforce may have long-term effects for the field.

The Climate Crisis & Resiliency Task Force

The Association of Children's Museums (ACM) established the ACM Climate Crisis & Resiliency Task Force to help the association rapidly respond to the environmental, social, economic, and humanitarian challenges affecting our institutions, communities, and core audiences worldwide.

Science Centers & Museums

Resources & Notable Moments

NSTA Science Update: Making Science Learning Lifelong, Lifewide and Lifedeep: What We Know About the Importance of Out-of-School Science Learning

Dennis Schatz

This 2019 presentation explored the evidence that out-of-school STEM learning is a key factor in developing youth interest in science. It also identified ways that educators have connected in-school and out-of-school experiences to enhance STEM learning.

ASTC 2019 Annual Conference

The conference theme was ***Moonshots*** and the **program** included preconference Intensive workshops, poster presentations, and sessions that explored how people and organizations are pursuing grand challenges.

Science Centers & Museums

Resources & Notable Moments

Creating the New Museum Definition: Over 250 Proposals to Check Out!

The current definition of museums has only seen minor adjustments over the past few decades. ICOM invited its members, committees, partners, and other interested stakeholders to help develop potential alternatives for a museum definition that reflects the complexities of the 21st century and the current responsibilities and commitments of museums to the communities they serve.

The Extraordinary General Conference Postpones the Vote on a New Museum Definition

The Extraordinary General Assembly of ICOM 2019 decided to postpone the vote on the new museum definition, as no consensus was reached after a debate in Kyoto.

ICOM international council of museums

Science Communication

Back to the list of sectors

Science Communication

By the Numbers

Trust and Mistrust in Americans' Views of Scientific Experts

Cary Funk, Meg Hefferon, Brian Kennedy, and Courtney Johnson

This Pew Research report showed that more Americans have confidence in scientists than in previous years, but there are political divides over the role of scientific experts in policy issues.

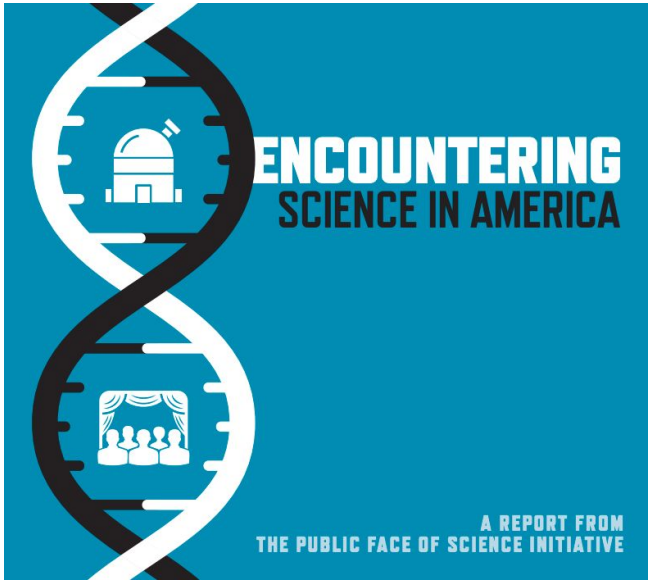
Encountering Science in America

American Academy of Arts and Sciences

This second report in the ***The Public Face of Science*** project highlighted the range and diversity of opportunities for science-centered activities—from aquariums, zoos, and science festivals to entertainment, news, and social media—and provided insight into why people engage.

The top 3 takeaways from this report:

- There is a diverse and expanding range of opportunities for people to encounter science, from visiting science centers and attending science events to participating in scientific research or engaging online.
- More social science research is needed to understand the impacts of science communication and engagement, including on public interest in, understanding of, and support for science.
- Understanding participant motivations is a critical component of effective science communication and engagement.



Science Communication

Select Publications

DE
AI

The Need for Feminist Approaches to Science Communication

Bruce Lewenstein

This introduction to the Fall 2019 special issue of the *Journal of Science Communication* focused on the importance of research and practice work in science communications that address equity, diversity, and inclusion. Articles featured in this issue are linked below to illustrate the range of perspectives represented in volume.

- **Feminist Standpoint Theory and Science Communication**
  Megan Halpern
- **Technoscience in the Era of #METOO and the Science March**
  Stephanie Steinhardt
- **Questioning the feminization in Science Communication**
  Tania Pérez-Bustos
- **Catch 22--Improving Visibility of Women in Science and Engineering for both Recruitment and Retention**
  Laura Fogg-Rogers and Laura Hobbs
- **What Role can Athena Swan Play in Gender Equity and Science Communication?**
  Clare Wilkinson
- **The Seeming Paradox of the Need for a Feminist Agenda for Science Communication and the Notion of Science Communication as a "Ghetto of Women's Over-Representation"**
  Elizabeth Rasekoala

Science Communication

Select Publications

DE
AI

Foundational Skills for Science Communication

Elyse L. Aurbach, Katherine E Prater, Emily T. Cloyd, and Laura Lindenfeld

This white paper presented a preliminary framework for foundational science communication skills developed by researchers and practitioners at the University of Michigan, the University of Washington, the Alan Alda Center at Stony Brook University, and the American Association for the Advancement of Science.

Strategic Science Communication as Planned Behavior: Understanding Scientists' Willingness to Choose Specific Tactics

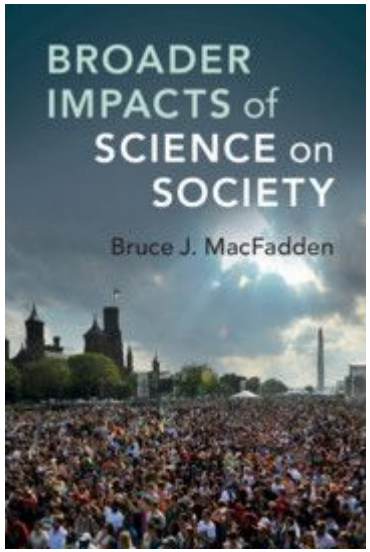
John Besley, Katherine O'Hara, and Anthony Dudo

This study aimed to advance a theory of strategic science communication as planned behavior by exploring Canadian scientists' self-reported willingness to prioritize six different tactics as a function of attitudinal, normative, and efficacy beliefs.

Broader Impacts of Science on Society

Bruce J. MacFadden

This book for scientists on broader impacts uses examples from National Science Foundation funded research and explores themes and best practices that are applicable globally for scientists, communicators and educators addressing the impacts of research on society.



Science Communication

Resources & Notable Moments

2019 American Association for the Advancement of Science (AAAS) Communicating Science Seminar

These archived videos were taken at the AAAS 2019 Communicating Science Seminar, which drew approximately 500 participants in February 2019, as part of the 2019 AAAS Annual Meeting in Washington, D.C.

2019 #SciEngage Meeting Videos

These archived videos show monthly virtual meetings on science communication–related topics led by staff from the National Academies of Sciences, Engineering, and Medicine; AAAS; and the Association of Science and Technology Centers (ASTC).

National Academy of Sciences Colloquium on Misinformation about Science in the Public Sphere

This colloquium in April 2019 examined the growing body of research on the factors that make people more or less likely to accept incorrect information presented by news media, social media, and other channels. NASEM has archived **videos** of the presentations by researchers and practitioners.

2019 Physics Education Research Conference (PERC)

The theme of the conference was **"Physics Outside of the Classroom: Teaching, Learning, and Cultural Engagement in Informal Physics Environments."** The conference served as an invitation for the physics education research community to engage in debate and discussion about learning environments other than formal classroom experiences. **Papers** addressing this year's theme, including CAISE Project Director Jamie Bell's **plenary paper** "Informal STEM education: From personal to professional," are archived.

Science Communication

Resources & Notable Moments

A Debate

The articles below describe the critical tension that emerged from research on the impact of consensus messaging that generated conflicting evidence and interpretations.

Psychological Reactance From Reading Basic Facts on Climate Change: The Role of Prior Views and Political Identification

Graham Dixon, Jay Hmielowski and Yanni Ma

This research showed that emphasizing the scientific consensus of climate change produces reactance, but only among people who question the existence of climate change.

Exposure to Scientific Consensus Does Not Cause Psychological Reactance

Sander van der Linden, Edward Maibach and Anthony Leiserowitz

This research found that although people who question climate change are more likely to say that the 97% consensus message is manipulative, this main effect exists regardless of experimental condition, indicating that psychological reactance does not stem from exposure to the scientific consensus.

Open Questions in Scientific Consensus Messaging Research

Asheley Landrum and Matthew Slater

This 2019 pre-publication essay focuses on some of the important questions that scholars might consider when researching scientific consensus messaging.

A Research Agenda for Climate Change Communication and Public Opinion: The Role of Consensus Messaging and Beyond

Robin Bayes, Toby Bolsen and James Druckman

This article reviews many of the studies that have been done on the impact of communicating the scientific consensus to the general public, discusses ongoing debates about these studies, and highlights complementary areas that could define future research on climate change communications.

Science Communication

Resources & Notable Moments

DE AI

#InclusiveSciComm Symposium

The 2019 symposium led by the Metcalf Institute at the University of Rhode Island built on an inaugural one in 2018. The public summary of the symposium took place in September 2019 and a selection of archived videos are available of some of the presentations.

Standing Committee on Advancing Science Communication Research and Practice

National Academies of Sciences, Engineering & Medicine, Division of Behavior & Social Sciences & Education

The Standing Committee archived videos of sessions from their September 2019 public meeting.

Catalyze: The Talks from TED@NAS

Erin Gregory, Maria Ladias, Oliver Friedman, Reid Catlett, Tom Carter, and Yasmin Belkhyr

This is a summary of a TED@The National Academy of Sciences science communication event in November 2019, in which 19 speakers and performers explored how science is igniting change and fueling our way forward through radical collaboration, quantum leaps, and bold thinking.

Science Communication

Resources & Notable Moments

The Center for Advancing Research Impact in Society (ARIS)

ARIS officially launched at the 2019 National Alliance for Broader Impacts (NABI) Summit in Tucson, AZ, April 30–May 2. The NSF-funded center will work with scientists and engagement practitioners to build capacity, advance scholarship, grow partnerships, and provide resources to help them engage with and demonstrate the impact of research in their communities and society. ARIS Principal Investigator Susan Renoe announced the ARIS center in this NABI Summit opening keynote.

The Michigan Public Engagement Framework

Elyse L. Aurbach, Ellen Kuhn, and Rachel Niemer

This Public Engagement Framework uses the elements of people, relationships, and context as entry points for understanding both the unique and similar facets of any engagement effort.

Stepping Up, Stepping Back: New Leadership and Next Steps for the SciComm Training Network

Amanda Stanley and Laura Lindenfeld

This blog from the nonprofit COMPASS described the SciComm Training Network's February 2019 summit. This convening was designed with the goal to refine the characteristics and critical Issues that could be addressed by the training network.

The attendees of the 2019 SciComm Training Network Summit. Photo by the Chan Zuckerberg Institute.

Youth & Afterschool

Back to the list of sectors

Youth & Afterschool

By the Numbers

DE AI

STEM Learning Ecosystems

Fall 2019 Community of Practice Convening theme was *LIving STEM: Communities at the Heart,* Cleveland, OH. This meeting featured:

- **1,200 speakers**
- **>400** global leaders from **84** STEM Ecosystems
- **59** honorees were identified as **Women Living STEM** in Northeast Ohio and were celebrated at an **evening event**

Afterschool Alliance

In October 2019, **Lights on Afterschool** celebrated its 20th Anniversary! Landmarks across the country lit up in yellow and blue to support the afterschool programs that keep kids safe, inspire them to learn, and give working parents peace of mind each afternoon after the school day ends and before parents get home from work. View **highlights** shared by event participants from across the nation.

- More than **1 million** students, parents, educators, business and faith leaders, policy makers, and community members participated in events to show their support for afterschool experiences.
- **10,000** events were held—the most ever in the organizations history.

Youth & Afterschool

Select Publications

DE AI

Learning Across Boundaries: How Parents and Teachers are Bridging Learning Across Settings

Lori Takeuchi, Sarah Vaala, and June Ahn

Researchers at the Cooney Center and UC Irvine conducted surveys with 1,550 U.S. parents and 600 pre-K–8 teachers to paint a more comprehensive picture of whether, to what extent, and how children ages 3–12 are linking their learning experiences across home, school, and community.

DE AI

Changing the Game in STEM with Family Engagement. A White Paper For Practitioners and Field Leaders to Empower Families in STEM

Linda Kekelis and Kara Sammet

Parents are vital players in raising youth awareness of the value of STEM and in brokering youth participation in activities that build STEM competencies.

Photo Courtesy: New York Hall of Science

Youth & Afterschool

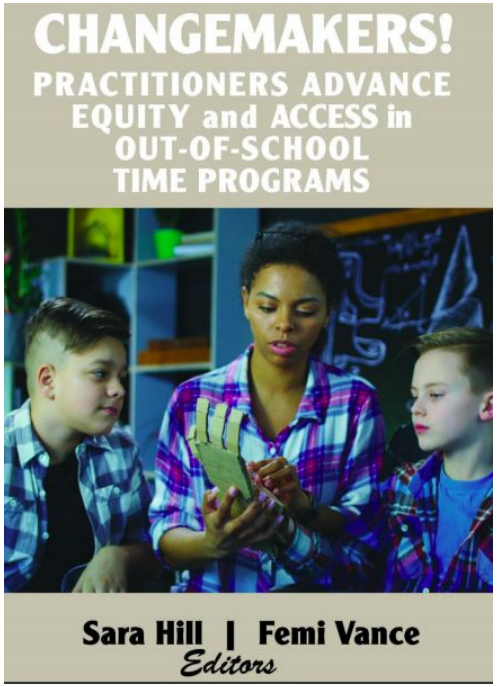
Select Publications

DEAI

Changemakers! Practitioners Advance Equity and Access in Out-of-School Time Programs

Sara Hill and Femi Vance (editors)

This book illustrates the tensions that arise when organizations and OST professionals try to engage all youth, especially the traditionally underserved populations—when infrastructure, funding, and mindsets have not kept pace with the evolving needs of youth and their communities. A slide presentation about these topics can be found here.



Early Informal STEM Experiences and STEM Identity: The Importance of Talking Science

Remy Dou, Zahra Hazari, Katherine Dabney, Gerhard Sonnert, and Philip Sadler

This paper examined the relationship between participants' childhood science, technology, engineering, and mathematics (STEM) related experiences, their STEM identity (i.e., seeing oneself as a STEM person), and their college career intentions. Analysis revealed that for every point higher on the STEM identity scale, participants' odds of choosing a STEM career in college increased by 85%. The paper is available for free download from EBSCO database for InformalScience.org **members**.

The Unique Challenges of Afterschool Research

Lizzie Murchison, Katie Brohawn, Cheri Fancsali, Andrea D. Beesley, and Erin Stafford

Funders and policymakers are increasingly recognizing the afterschool field for its vital role in supporting the social and emotional growth and academic achievement of school-age youth. However, strong partnerships between practitioners and external evaluators are needed to meet funders requirements.

Youth and Afterschool

Resources & Notable Moments

DE AI

2019 The summer of STEM

Linda Kekelis

This blog highlights the importance of family engagement to address the "summer slide" particularly in under-resourced communities. Resource collections like these are regular features of the **family engagement project,** a multi-year initiative that facilitates convenings, publishes research briefs, and uses a national social media campaign to empower families to support children's engagement in STEM.

DE AI

Despite the Odds: Young Women Who Persist in Engineering

This executive summary is a starting point for all of us who are working to achieve gender parity in engineering: to build on what is working, to collaborate and improve on what we can do better, to investigate unanswered questions, and to continue the conversation about girls and women in engineering and technology.

The Family Engagement Playbook

Margaret Caspe, M. Elena Lopez, and Rachel Hanebutt

This is a collection of promising research-based approaches to strengthen the competencies of people, groups, and organizations that are dedicated to families. The Playbook offers ideas, models, and tools that can be easily integrated into training, continuing education, and organizational learning opportunities.

Other Notable Publications & Moments

Back to the list of sectors

Learning Science in Informal Environments

By the Numbers

In 2019, The National Research Council of the National Academies of Sciences, Engineering and Medicine consensus study report ***Learning Sciences in Informal Environments: People Places and Pursuits*** celebrated its **10th anniversary** of publication. Over the last decade, this resource has had a notable impact on the understanding of learning ecosystems.

Where has this resource been accessed?

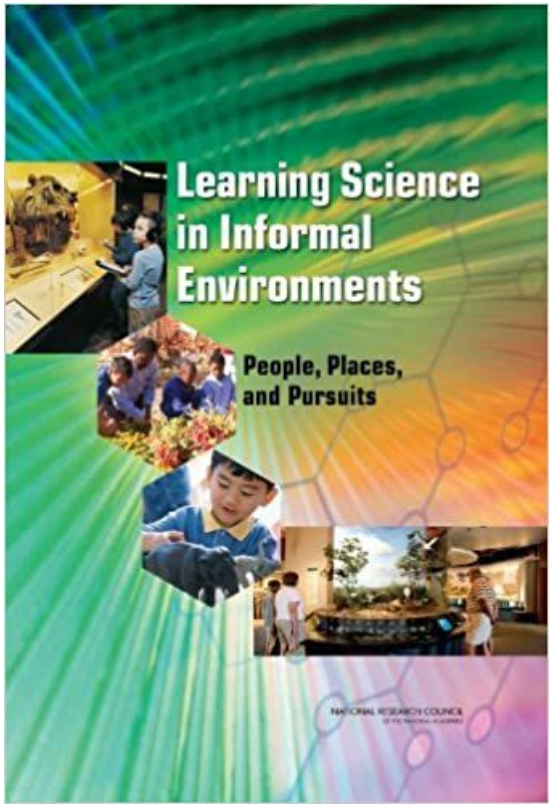
- Broad geographic reach--to **159** countries as well as downloads in all **50 states** and the District of Columbia.

How has this resource been accessed?

- Widely disseminated--with a total of **20,423** full text downloads, putting it in the top **1%** of all National Academies products and sent to over **49,679** email addresses

Who is exploring this work?

- Local, state, federal and military agencies accounted for **12%** of all downloads
- The research and academic community accounted for **25%** and the public at large accounted for the remaining **62%.**



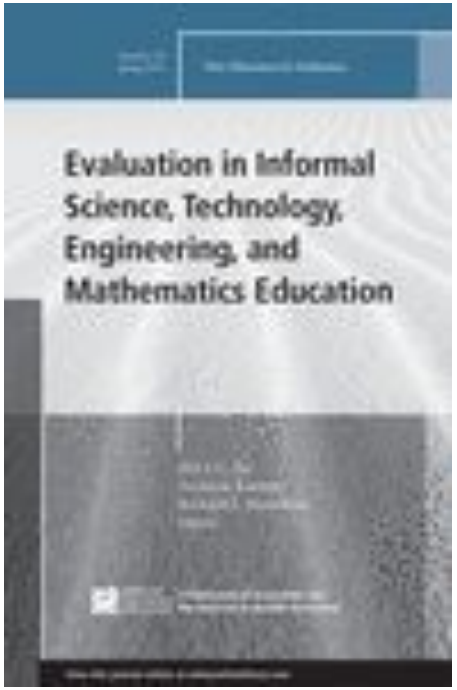
Field-Wide Research and Evaluation

Select Publications

Evaluation in Informal Science, Technology, Engineering, and Mathematics Education

Alice C. Fu, Archana Kannan, and Richard J. Shavelson (editors)

The editors' notes of this special issue of *New Directions in Evaluation* highlight the importance of increasing capacity for the evaluation of informal STEM learning opportunities. Articles featured in this issue and listed below provide insight into this rapidly growing interdisciplinary field. These papers are available for free download from EBSCO database for InformalScience.org **members**.



- **Evaluating Informal STEM Education: Issues and Challenges in Context**
  Sue Allen and Karen Peterman
- **Direct and Unobtrusive Measures of Informal STEM Education Outcomes**
  Alice C. Fu, Archana Kannan, Richard J. Shavelson
- **Shared Measures for Evaluating Common Outcomes of Informal STEM Education Experiences**
  Amy Grack Nelson,Megan Goeke,Ryan Auster, Karen Peterman, Alexander Lussenhop
- **Equity and Evaluation in Informal STEM Education**
  Cecilia Garibay, Rebecca M. Teasdale
- **Evaluation Capacity Building for Informal STEM Education: Working for Success Across the Field**
  Marjorie Bequette, Christopher L. B. Cardiel, Sarah Cohn, Elizabeth Kunz Kollmann, Frances Lawrenz

Field-Wide Research and Evaluation

Select Publications

Practical Program Evaluation

Beth Murphy

This editorial described the motivation for a themed issue of the online journal *Connected Science Learning* focused on program evaluation. Articles featured in this issue and listed below emphasized a utilization approach to evaluation.

- **Evaluating Nature Museum Field Trip Workshops**
  Caroline Freitag and Melissa Siska
- **Learning Design Experiments** Peter Wardrip, Lisa Brahms, and Annie McNamara
- **Formative Assessment of STEM Activities in Afterschool and Summer Programs** Cary Sneider and Sue Allen
- **Team-Based Inquiry-Using Evaluation to Improve Educational Experiences** Sarah Cohn
- **Shared Measures for STEM and Science Learning Through the ActApp** Matthew A. Cannady and Kalie Sacco
- **Planning for Quality: A Research-Based Approach to Developing Strong STEM Programming** Lydia Peabody, Rebecca K. Browne, Bailey Triggs, Patricia J. Allen, and Gil G. Noam
- **The Common Instrument Suite: A Means for Assessing Student Attitudes in STEM Classrooms and Out-of-School Environments**
  Cary Sneider and Gil G. Noam

Field-Wide Commitment to Equity and Inclusion

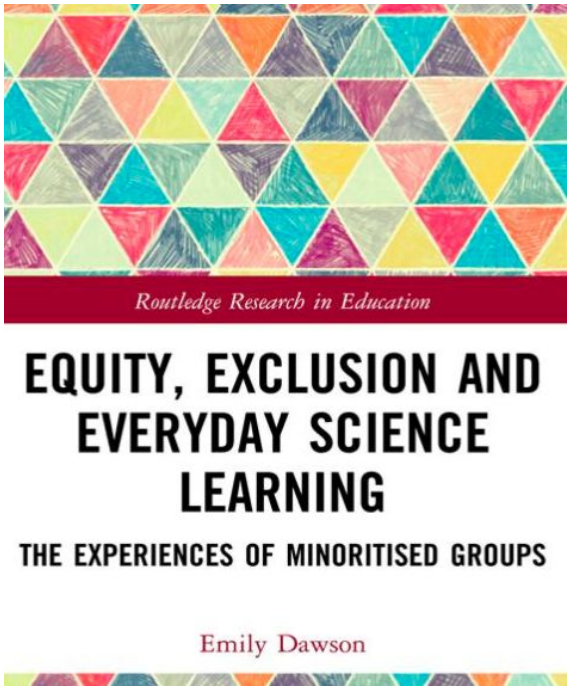
Select Publications

DE AI

Equity, Exclusion, and Everyday Science Dialogue

Emily Dawson

This book explored how some people are excluded from science education and communication. Taking the role of science in society as a starting point, it critically examined the concept of equity in science learning and developed a framework to support inclusive change. A "zine" that summarizes and illustrates the book's content by Sophie Wang is available for free download **here**.



DE AI

Equity and Evaluation in Informal STEM Education

Cecilia Garibay and Rebecca M. Teasdale

This chapter considered the role that evaluation can play in helping the field adopt more inclusive practices and achieve greater equity than at present through evaluation that addresses sociopolitical contexts and reflects the perspectives and values of non-dominant communities. At the field-wide level, evaluators are encouraged to examine conceptualizations of "broadening participation in STEM," evaluate community-based partnerships, and address replication and scaling.

Field-Wide Commitment to Equity and Inclusion

Resources & Notable Moments

DE AI

NSF INCLUDES Coordination Hub and National Network Launched

The NSF INCLUDES Coordination Hub was launched in September 2018 and the National Network online community was launched in May 2019. The Coordination Hub is a partnership among organizations with varied expertise. The Coordination Hub facilitates the development of partnerships among stakeholders across the public, private and academic sectors; shares promising practices and other useful data for broadening participation; contributes to the knowledge base on broadening participation in STEM through research, and provides a framework for supporting communications and networking among partners.

NSF INCLUDES National Network

STEM & Learning Trends

Resources & Notable Moments

DE AI

NASA's Science Activation Program: Achievements and Opportunities

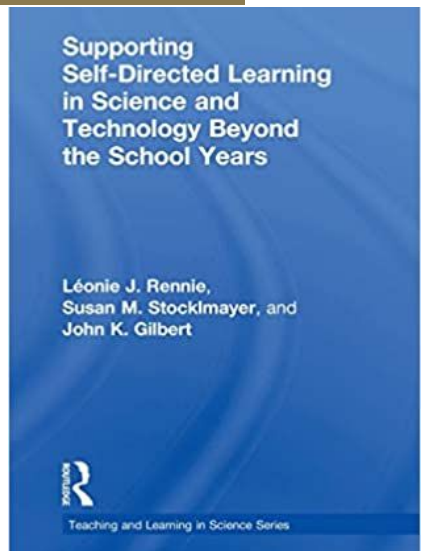
Margaret A. Honey, Kenne A. Dibner, and Tiffany E. Taylor (editors)

This report described and assessed the history, current status, and vision of the SciAct program and its projects. The key objectives of the program are to enable STEM education, improve U.S. scientific literacy, advance national education goals, and leverage efforts through partnerships. The program aims to bring unique NASA expertise and assets, including people, missions, products, data, and scientific results, to a diversity of learners effectively and efficiently.

Supporting Self-Directed Learning in Science and Technology Beyond the School Years

Leonie J. Rennie, Susan M. Stocklmayer, John K. Gilbert

This book explores adult and lifelong learning in science and technology by identifying the knowledge and skills that individuals need to engage in self-directed learning. Through case studies the authors consider how tools can best support adults' learning experiences in a wide range of environments. This **blog post** by **Leonie Rennie** provides additional insights into the content of the book.



Thank you for reading!

We welcome your feedback on what you found useful, how we might improve this resource, and what should be included in 2020.
Email caise@informalscience.org.

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