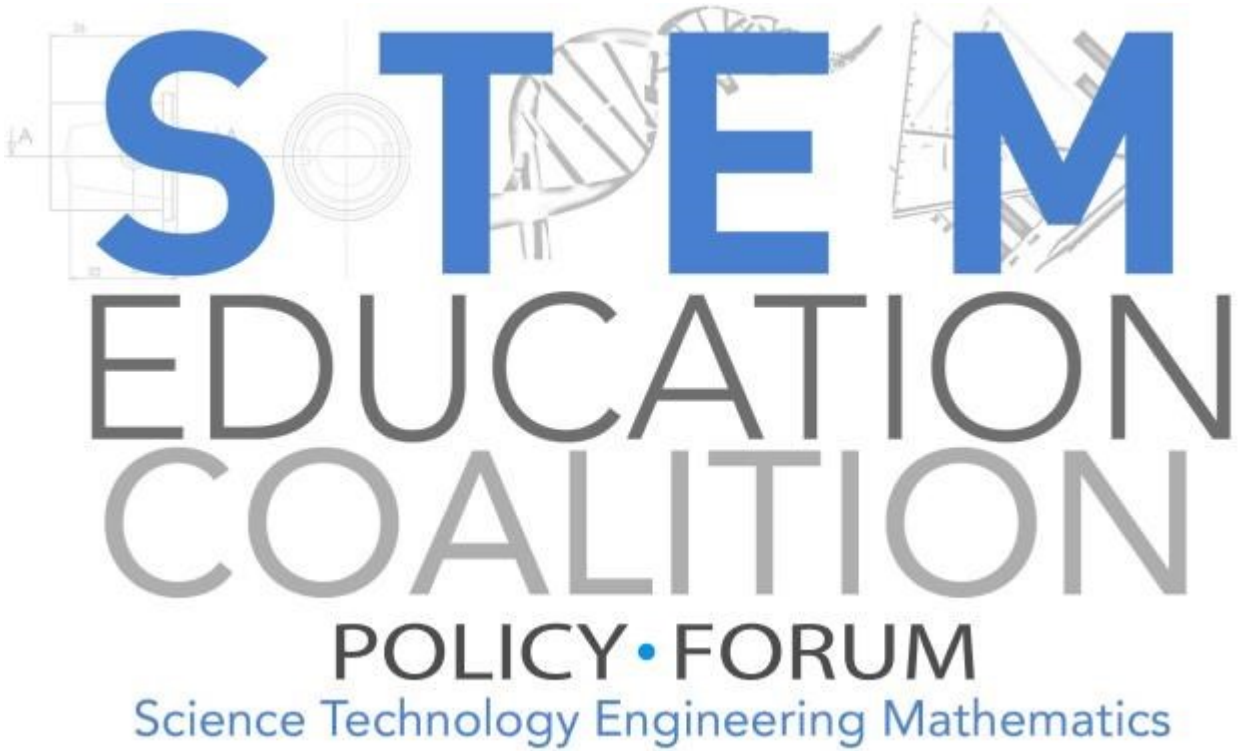
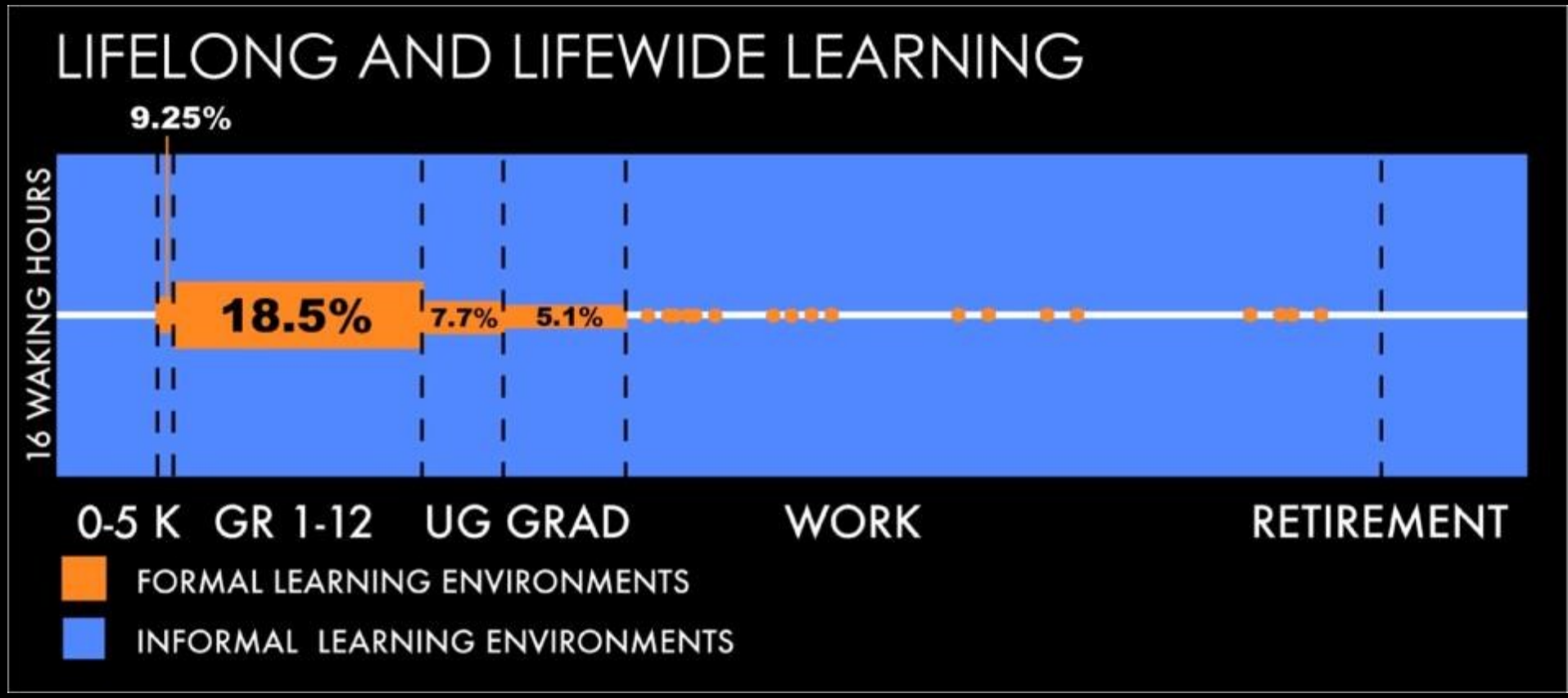
Informal STEM Education 101:
What We Know and Don't: The State of the Art on Research on Outcomes in Informal STEM Education

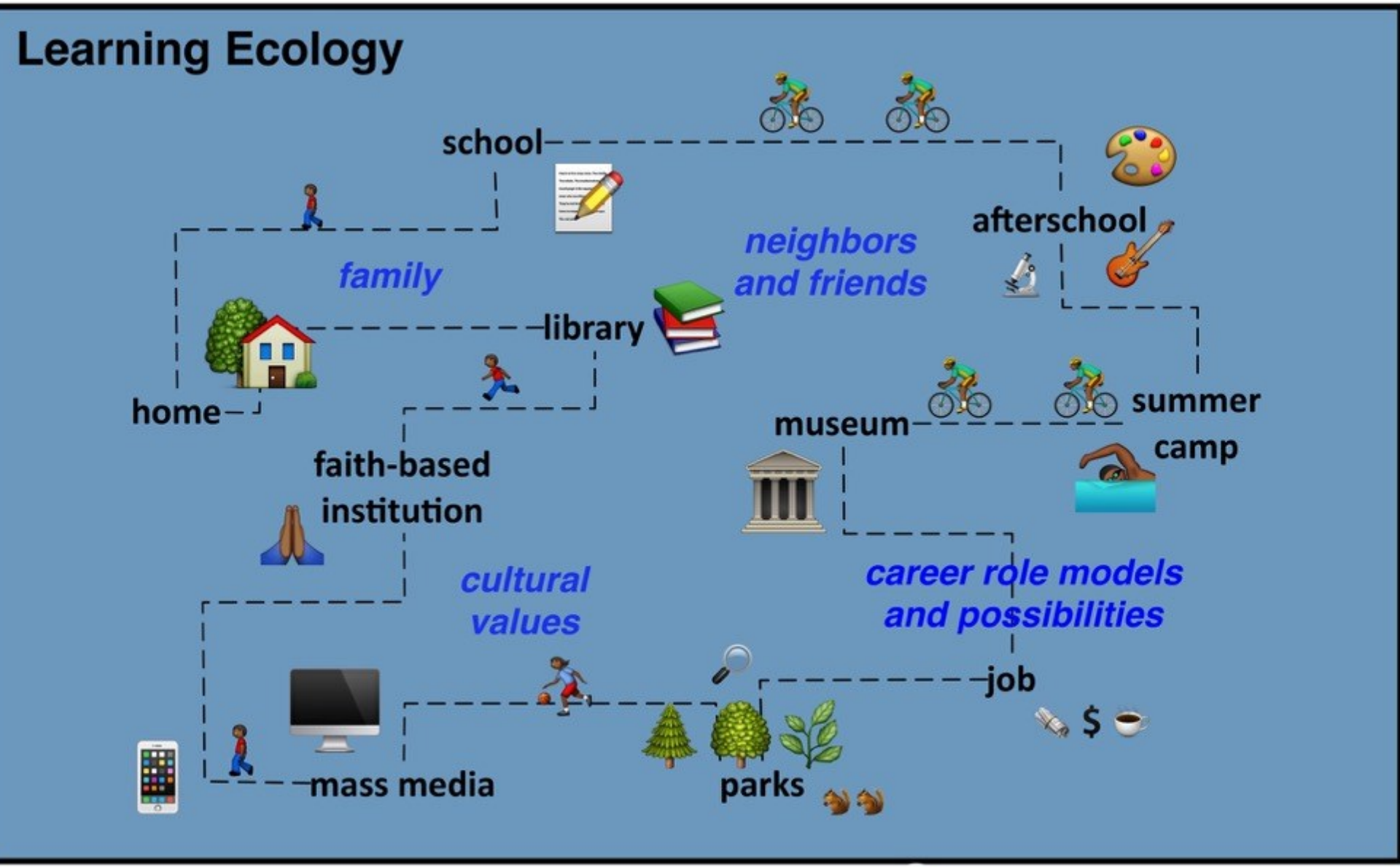


April 28, 2016

STEM LEARNING AND OST

@BronwynBevan,
University Of Washington


LIFELONG AND LIFEWIDE LEARNING
9.25%
16 WAKING HOURS
18.5%
7.7%
5.1%
0-5 K
GR 1-12
UG GRAD
WORK
RETIREMENT
FORMAL LEARNING ENVIRONMENTS
INFORMAL LEARNING ENVIRONMENTS



Research+Practice Collaboratory. 2015

WHAT IS OUT-OF-SCHOOL TIME STEM LEARNING?

Everyday Learning	Self-Directed Learning	Structured, Supervised Learning
Home/Family	On-Line	Afterschool Programs
Community	Radio, TV, Film	Weekend Classes
School Yard	Museums	Summer Camps
Social Media	Books/Libraries	Internships
On-the-Job	Hobbies, Clubs	Clubs

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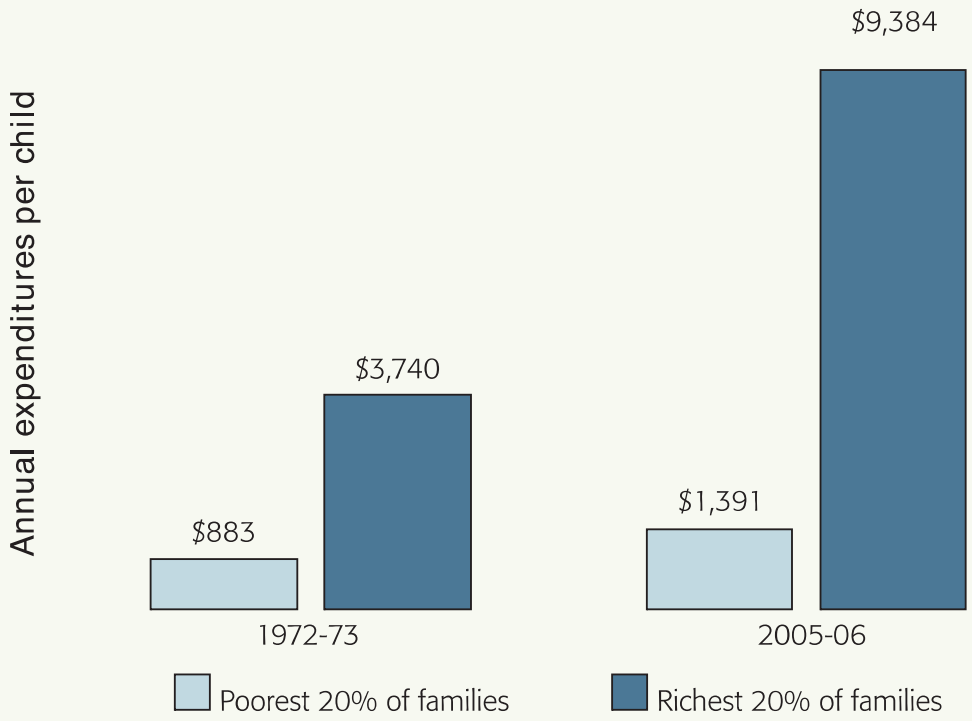
SOCIAL AND INTEREST-DRIVEN

WHAT IS OUT-OF-SCHOOL TIME STEM LEARNING?

Everyday Learning	Self-Directed Learning	Structured, Supervised Learning
Home/Family Community School Yard Social Media On-the-Job	On-Line Radio, TV, Film Museums Books Hobbies, Clubs	Afterschool Programs Weekend Classes Summer Camps Internships
50M PK-12 Youth	**50M PK-12 Youth**	**20M? Youth** 10M=6M 4-H, 4M B&G Clubs 10M=9M the Y, 1.6M 21CCLC 10M?=Museums, Libraries, Nature Centers, Community Programs
Social Policies	Cultural Policies	Educational Policies

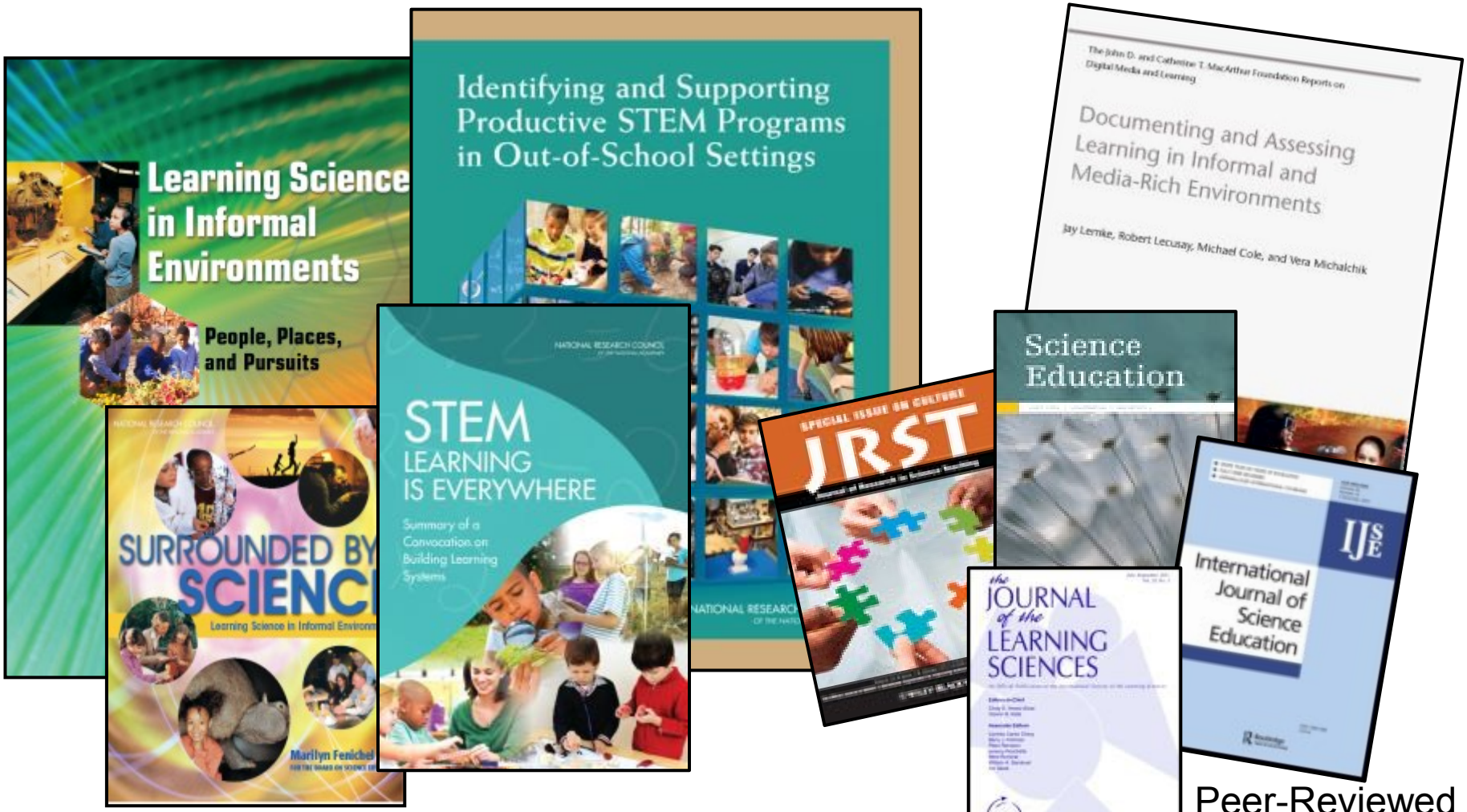
FIG. 4.

Family enrichment expenditures on children



Author's calculations are based on data from the Consumer Expenditure Surveys. Expenditure patterns vary across families and include child care. Books, fees for sports activities and equipment, and summer camp enrollment fees are examples of common "child enrichment" expenditures. Amounts are in 2012 dollars. Reprinted with permission from Whither Opportunity? © 2011 Russell Sage Foundation.

RESEARCH JOURNALS AND SYNTHESES



National Research Council Consensus Studies

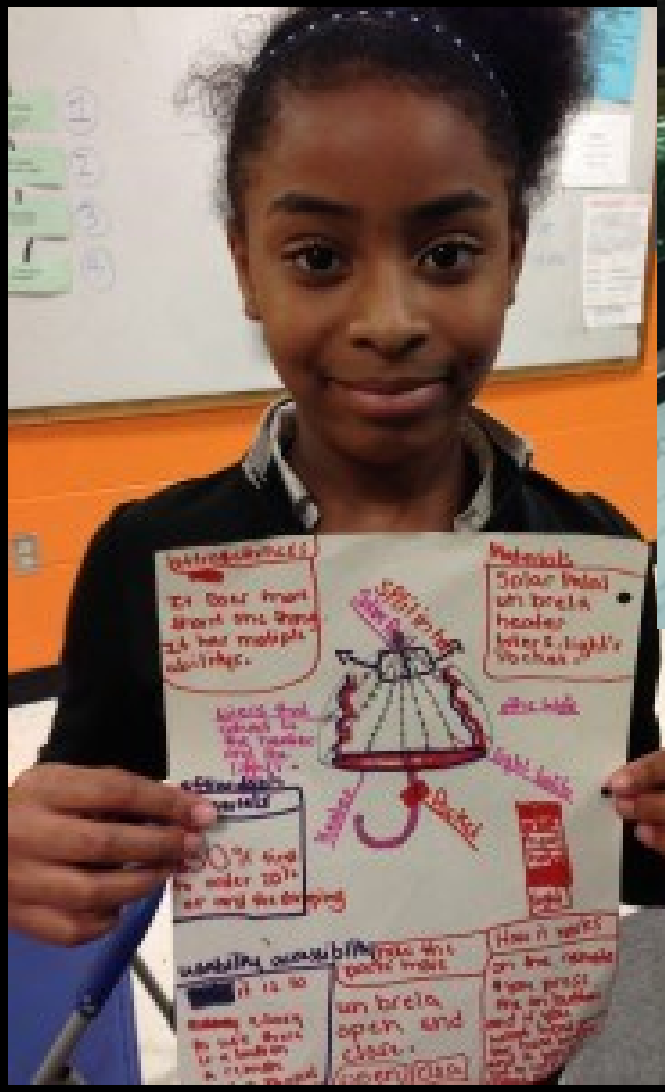
Peer-Reviewed Journals

STEM LEARNING: WHAT RESEARCH SAYS

- **Learning develops across settings and over time**
  (National Research Council, 2002)
- **STEM learning is best accomplished through firsthand engagement in STEM practices**
  (National Research Council, 2012a)
- **21st c skills promote deeper learning**
  (National Research Council, 2012b)

HIGH QUALITY STEM LEARNING IN AFTERSCHOOL (NRC, 2015)

- **Provides first-hand experiences with phenomena, concepts, and practices that are both intellectually and socio-emotionally engaging.**
- **Recognizes and leverages/builds on young people's interests, prior experiences, and cultural resources (which vary across communities).**
- **Actively makes connections to STEM ideas and experiences in school, at home, and in future learning and work opportunities (which vary across communities).**



GET City (Boys & Girls Club)

Calabrese Barton & Tan, 2010

IMPLICATIONS OF RESEARCH

- **OST sector is a powerful resource waiting to be tapped, serving 10-15M youth/year, and primed to expand STEM education.**
- **Robust STEM learning ecologies contain multiple, varied, and locally adapted programs that can address all students' interest and needs as they change, evolve, and fluctuate over time.**
- **To broaden participation in STEM, communities need to actively ensure that students from low income communities have access to responsive, engaging OST STEM. And there is a need to actively broker/connect youth to additional ongoing learning opportunities.**

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College OF Education

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REFERENCES

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Azevedo, F. S. (2011). Lines of practice: A practice-centered theory of interest relationships. *Cognition and Instruction, 29*(2), 147-184.

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development, 49*, 193–224.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111-127.

Ito, M., Gutiérrez, K., Livingstone, S., Penuel, W., Rhodes, J., Salen, K., . . . Sefton-Green, J. (2012). *Connected learning: An agenda for research and design*. Retrieved from Chicago: http://dmlhub.net/publications/connected-learning-agenda-for-research-and-design/

Maltese, A. V., & Tai, R. H. (2011). Pipeline Persistence: Examining the Association of Educational Experiences With Earned Degrees in STEM Among U.S. Students. *Science Education, 95*, 877-907.

National Research Council and Institute of Medicine. (2002). *Community programs to promote youth development*. Washington, DC: National Academy Press.

National Research Council. (2012a). A *framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington DC: The National Academies Press.

National Research Council. (2012b). *A Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century.* Washington DC: The National Academies Press.

National Research Council. (2015). *Identifying and Supporting Productive Programs in Out-of-School Settings*. Washington, DC: The National Academies Press.

Root-Bernstein, R., & Pathak, A. (2016). *A Review of Studies Demonstrating the Effectiveness of Integrating Arts, Music, Performing, Crafts and Design into Science, Technology, Engineering, Mathematics and Medical Education*. Michigan State University. Lansing, MI.

Tai, R. H., Liu, C. Q., Maltese, A. V., & Fan, X. (2006). Planning early for careers in science. *Science, 312*(5777), 1143-1144.

Wai, J., Lubinski, D., Benbow, C. P., & Steiger, J. H. (2010). Accomplishment in science, technology, engineering, and mathematics (STEM) and its relation to STEM educational dose: A 25-year longitudinal study. *Journal of Educational Psychology, 102*(4), 860-871.

STEM EDUCATION COALITION

POLICY • FORUM

Science Technology Engineering Mathematics

Informal STEM Education 101: Connecting Research & Practice in Informal STEM Education

James Bell
Project Director
Center for Advancement of Informal Science Education (CAISE)

This material is based upon work supported by the National Science Foundation (Award Nos. DRL-0638981 / DRL-1212803). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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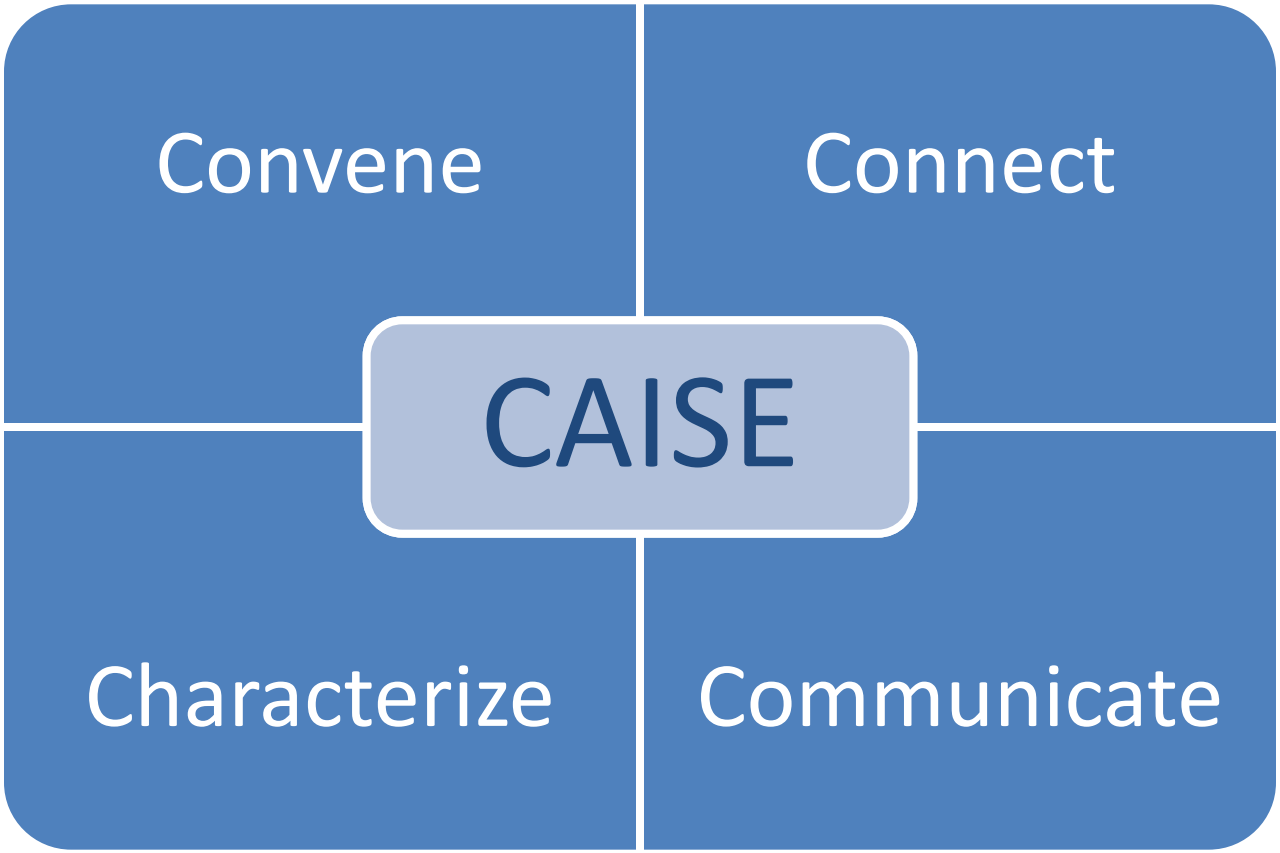

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InformalScience.org is a central portal to project, research and evaluation resources designed to support and connect the informal STEM education community in museums, media, out-of-school and a growing variety of learning environments.

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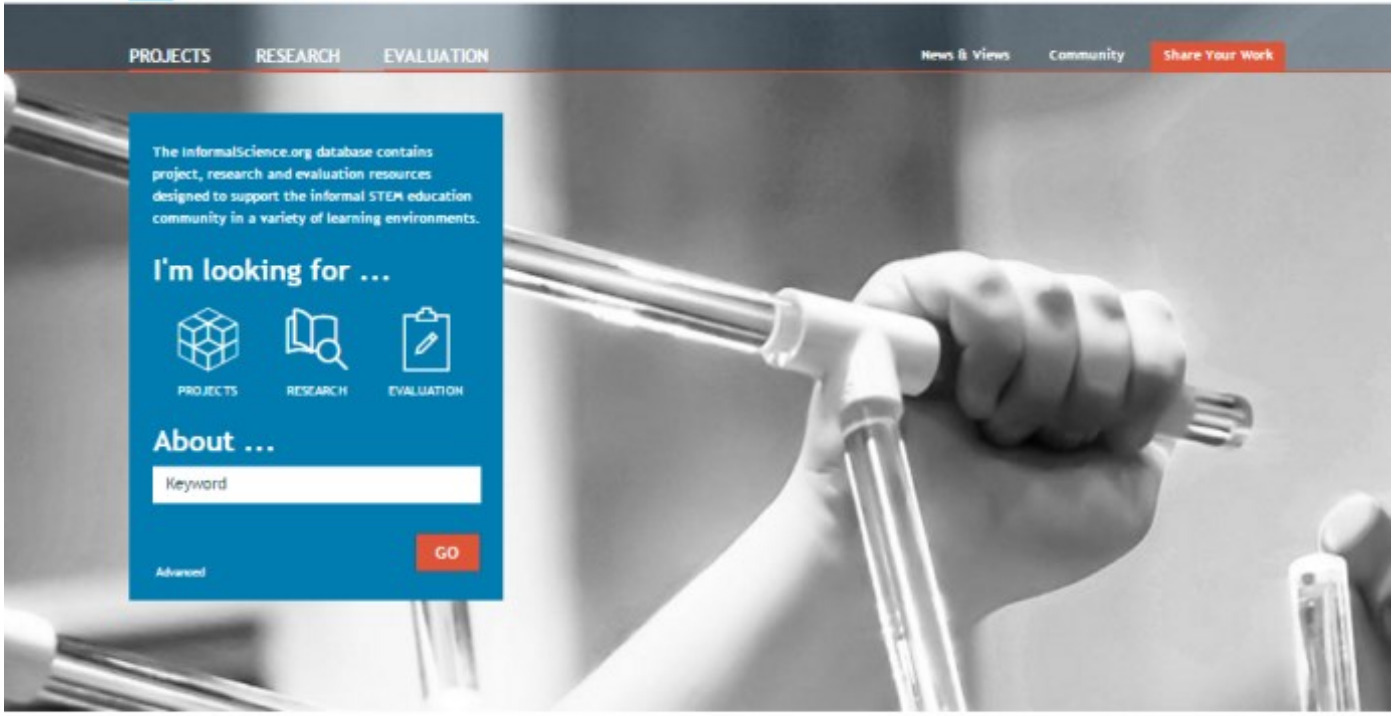
Assessment Tools in Informal Science (ATIS)
Ratings and Reviews
PEAR

JCOM
JOURNAL OF SCIENCE COMMUNICATION



Scientists and Public Engagement

RESOURCES FOR BROADER IMPACTS

Scientists can collaborate with the ISE community and use informal STEM learning strategies to engage the public with the content, process and broader impacts of their research.

OUTREACH

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Youth Access & Equity in ISL	• How can researchers and practitioners work collaboratively with youth to create more equitable ISE environments and settings? • Audience: Youth from Underrepresented Groups, Researchers, Practitioners
STAR Library Network	• In what ways do libraries serve as an environment for STEM learning? • Audience: Youth, especially rural regions
Synergies	• How do a variety of informal STEM experiences influence urban youth over time? • Audience: Urban youth
Activation Lab	• What interests, skills, and knowledge do children need to succeed and persist in future STEM experiences? • Audience: Youth
California Tinkering Afterschool Network	• What does STEM-rich, equity-oriented tinkering look like in out-of-school settings, and what kinds of professional learning is needed to support it? • Audience: Youth, Practitioners

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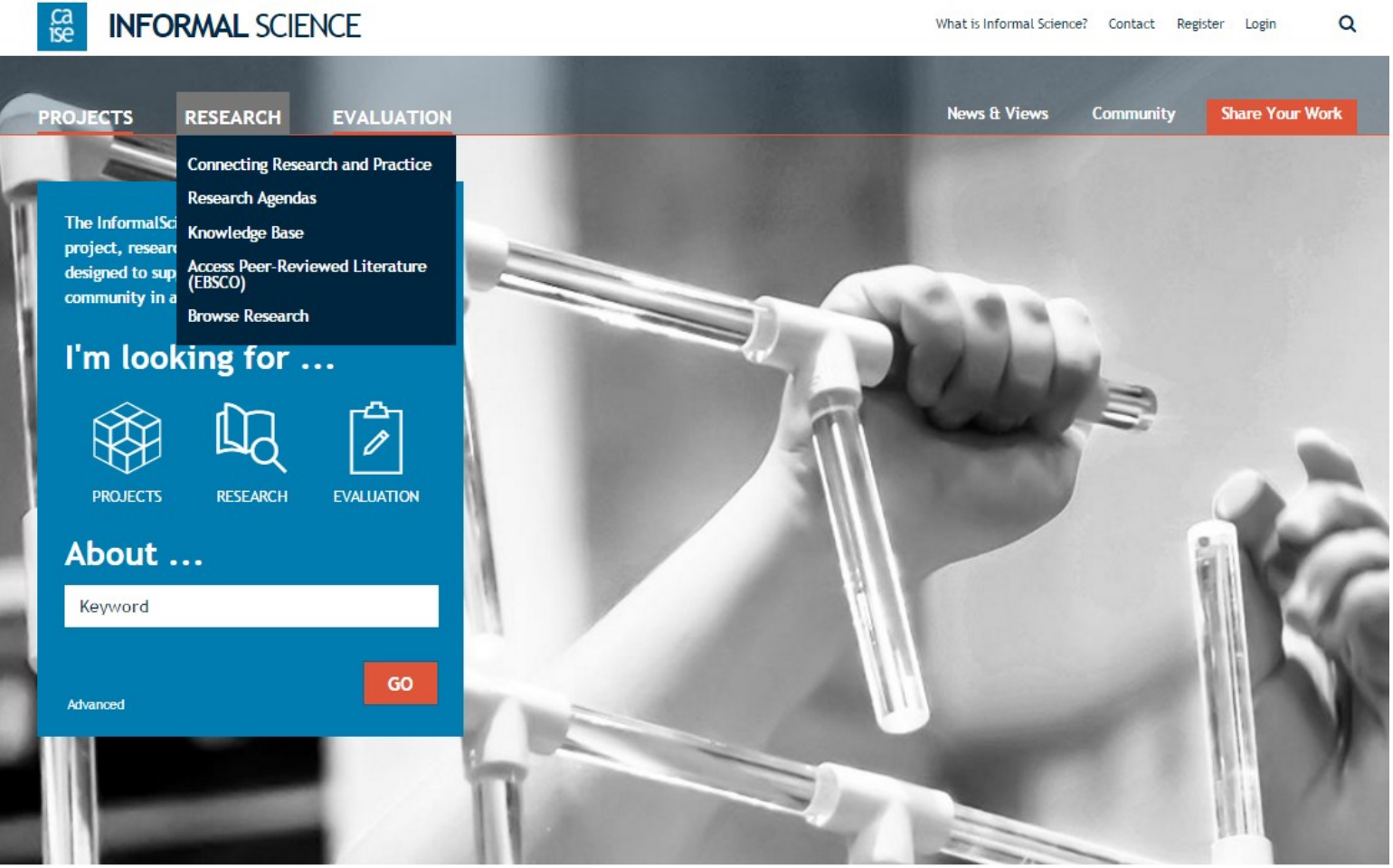

Documentation from the NSF AISL PI Meeting 2016

FEBRUARY 29-MARCH 2, 2016

CAISE hosted the 2016 NSF AISL Principal Investigator Meeting on February 29th - March 2nd, 2016. Slides and documentation are now available...

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Scientists and Public Engagement

RESOURCES FOR BROADER IMPACTS

Informal STEM Education networks and organizations have developed resources and expertise to help the STEM research community design and evaluate outreach, engagement and broader impacts activities.

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- **Zoos & Aquaria**
- **Natural History Settings**
- **Children's Museums**

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KNOWLEDGE BASE

The Knowledge Base (formerly the ISE Evidence Wiki) is a collaboratively generated resource designed to streamline access to and share evidence about the impacts of informal STEM learning on a range of audiences in a variety of settings. Articles in the Knowledge Base are intended to be evidence-supported claims that can be referenced when developing proposals or "making the case" for a strategy or approach to funders and stakeholders, as well as to see what is known and emerging in the field.

Are you interesting in contributing to the Knowledge Base? Contact caise@informalscience.org in order to edit existing articles or to create new ones.

Search our knowledge base. Select from one of three categories below.

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Results RESET

Adults | Programs, Online & Mobile Technology

Adult Informal Science Education Programs

There are a variety of informal science education programs that target adult learners. These programs exist along a continuum from casual drop-in programs (e.g., 1-2 hour workshops or lectures on...

ISE 101, Ecosystems of STEM Learning

Affective experiences are an important part of informal science education

Fun, excitement, pleasure, enjoyment, delight, laughter, wonder, joy are all emotional states that many informal science educators desire learners to associate with science learning. Yet in formal...

Broadcast Media & Film

Broadcast Television and STEM Learning

Broadcast television offers a variety of ways to present STEM-content and informal science education programming to public audiences. The educational program "Watch Mr. Wizard" (NBC 1951-1965)...

Children (6-12) | Broadcast Media & Film, Games & Cyberlearning, Online & Mobile Technology | Ecosystems of STEM Learning

Children learn more across multiple types of media and ISE experiences

Numerous research studies have demonstrated that educational media can produce significant STEM learning among children. Viewing of educational television has been found to contribute to children's...

- **53 articles and growing**

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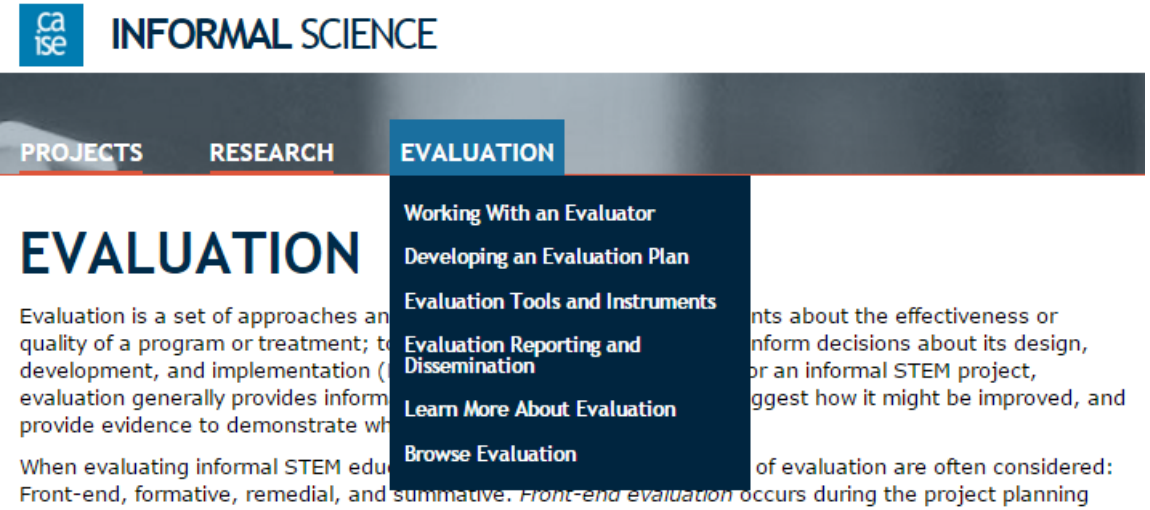

- **ATIS**
- **DEVISE**
- **Learning Activation Lab**
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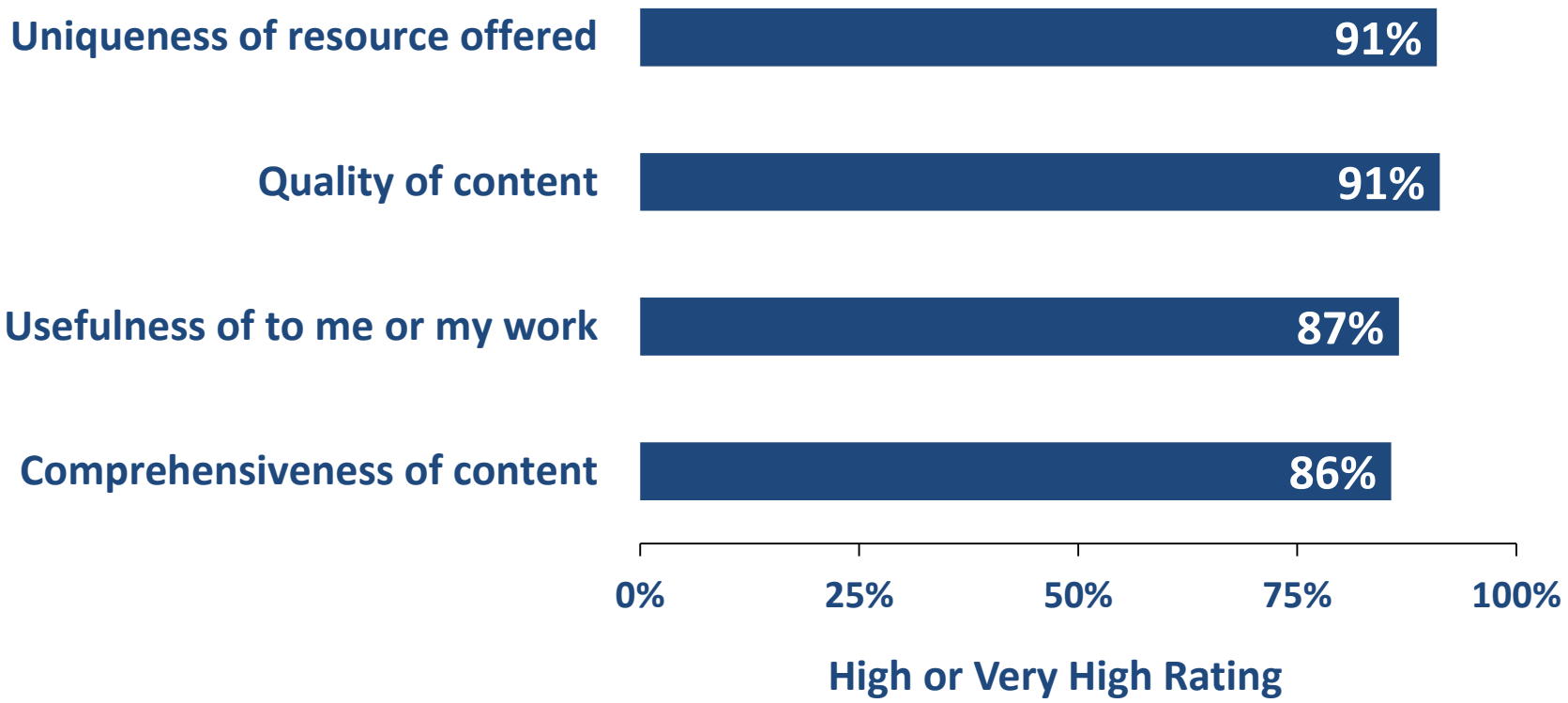

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