Defining Youth Outcomes for **STEM** Learning in Afterschool
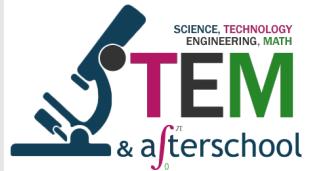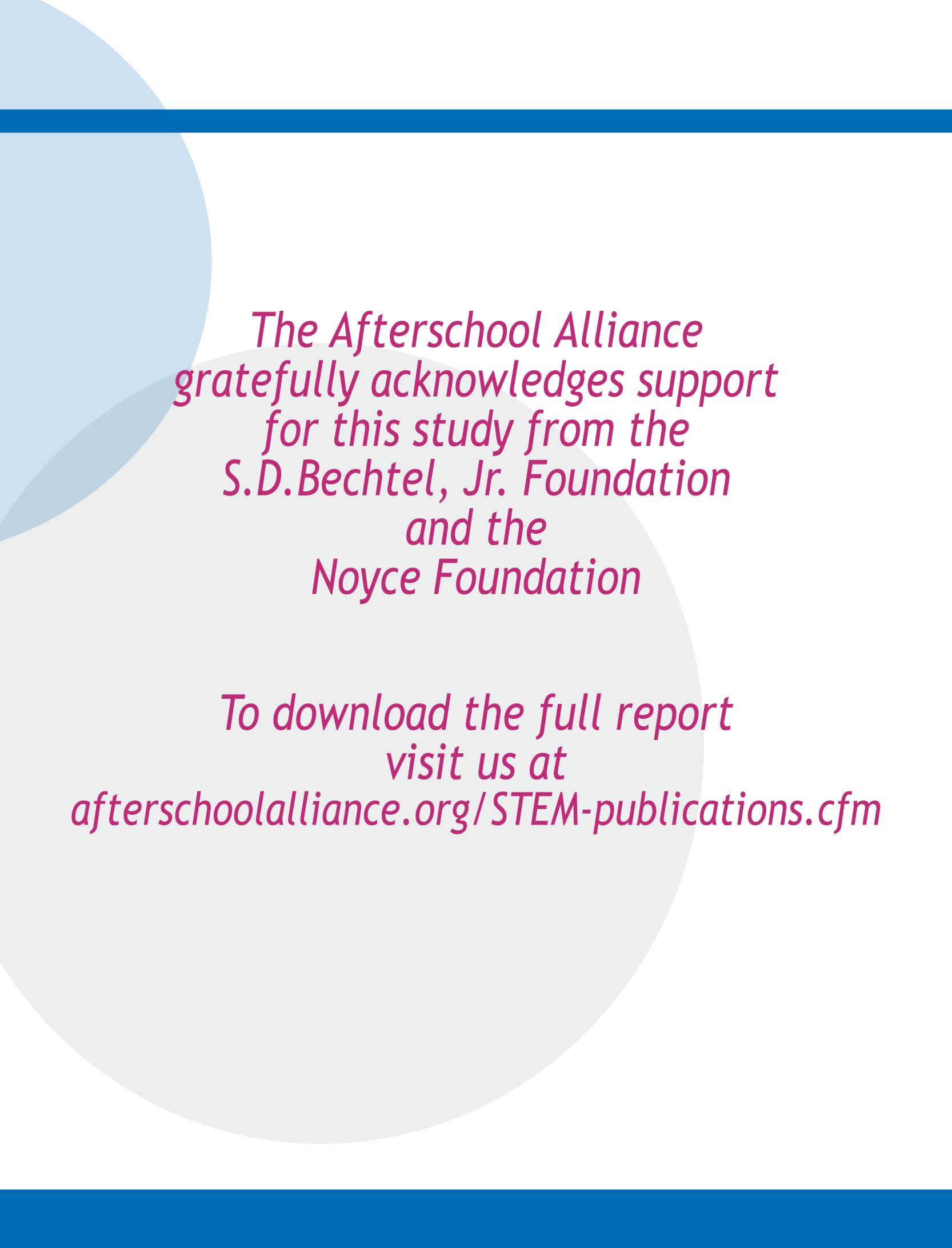
Executive Summary
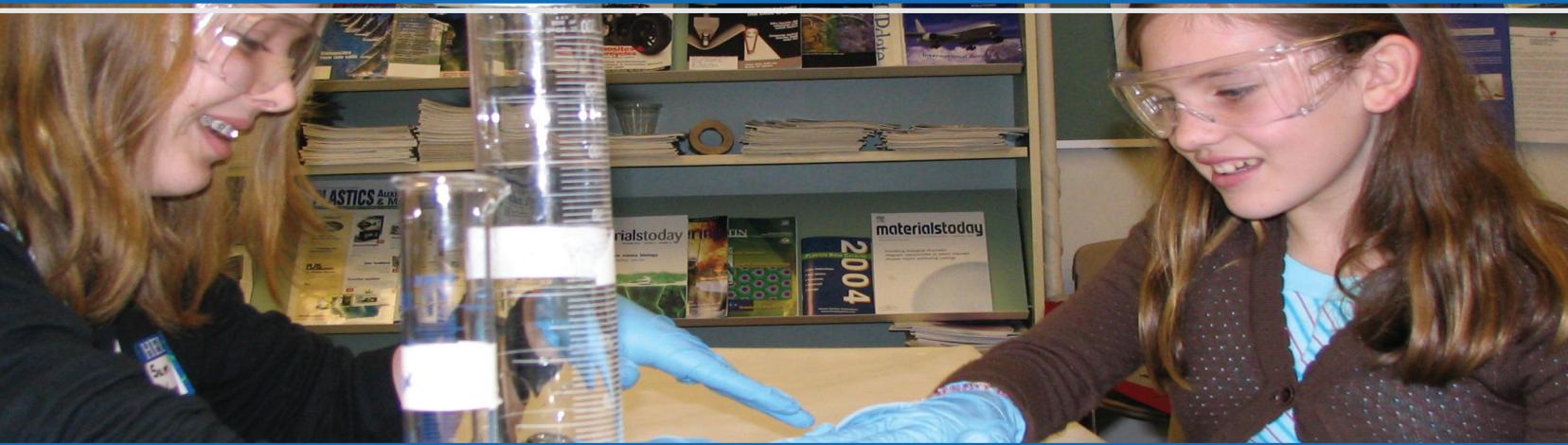
Afterschool Alliance

SCIENCE, TECHNOLOGY
ENGINEERING, MATH

STEM & afterschool

Afterschool programs are increasingly recognized as playing a valuable role in improving science, technology, engineering and mathematics (STEM) education. However, the expectations for how such programs support young people's STEM engagement and learning are varied. The *Defining Youth Outcomes for STEM Learning in Afterschool* study aimed to identify what STEM learning outcomes these program leaders and supporters believe that afterschool programs could contribute to, what the indicators of progress toward such outcomes might be, and what types of evidence could be collected by afterschool programs, without regard to whether or not appropriate data collection tools currently exist.

While many afterschool programs already engage children and youth in STEM, their role in supporting children's STEM learning is expected to grow in importance with the advent of the Common Core Standards for Mathematics and English Language Arts (which include literacy in science and technical subjects) as well as the Next Generation Science Standards. Over the next several years—as federal education initiatives such as Race to the Top and Investing in Innovation are implemented, reauthorization of the Elementary and Secondary Education Act progresses and new state assessment measures are developed—policies that directly affect the funding and focus of many afterschool programs will take effect. Given this crucial time in the development of afterschool STEM programs, reaching greater clarity about appropriate afterschool STEM learning goals and outcomes is essential to helping frame how afterschool is best positioned to support STEM learning.

In the robust, fast-growing and diverse field of afterschool, achieving consensus on important learning outcomes is not trivial. Afterschool programs are highly distinct from one another, serving different age groups, relying on different localized resources and pursuing different types of learning goals. To make headway on a process of distilling the experience and insight of expert afterschool practitioners and national and state education leaders, the *Defining Youth Outcomes for STEM Learning in Afterschool* study used a Delphi methodology, which seeks to achieve consensus across disparate expert perspectives. Over three rounds, conducted using online instruments, we surveyed two groups of experts: a panel of 55 afterschool "providers" (experienced afterschool leaders who were responsible for selecting, designing, or leading programming; professional development; and delivering on outcomes at a program-wide level) and a panel of 25 afterschool STEM "supporters" (such as funders, national education policy leaders and state education department representatives who were responsible for funding, policy decisions and establishing outcomes for afterschool programs to which providers must answer). The selection of these experts is described in the full report.

The consensus set of outcomes and indicators produced through this study is not intended to represent a set of mandatory goals for all afterschool STEM programs, as the afterschool STEM field is diverse and impacts are entirely dependent upon the particular circumstances (age of participants, resources, goals, community context) of each program. Rather, the outcomes, indicators and sub-indicators identified through this study are intended to help provide a common framework and language for programs to utilize as they define appropriate goals for their programs and then describe the impact of their afterschool STEM program. This will allow for aggregation of impacts across programs so that we may better describe the contributions of afterschool programs to the larger issues in STEM education.

Results

The study yielded consensus about three major outcomes for children and youth participating in afterschool STEM programs and a set of indicators and sub-indicators that support these outcomes (see Table A).

These broad developmental outcomes and indicators of learning reflect constructs found in evaluation reports of afterschool STEM programs (Afterschool Alliance 2011) as well as the research literature pertaining to human development (e.g., Hidi & Renninger 2006; Holland et al. 1998; Lave & Wenger 1991), youth development (e.g., Barber et al. 2005; Eccles 2005) and science learning (e.g., NRC 2007; NRC 2009).

Table A.

Consensus Developmental Outcomes and Learning Indicators for STEM in Afterschool

Developmental Outcome	Indicators of Progress	Sub-Indicators
1. Youth develop interest in STEM and STEM learning activities	• Active participation in STEM learning opportunities • Curiosity about STEM topics, concepts or practices	• Active engagement and focus in STEM learning activities • Pursuit of out-of-school-time STEM learning opportunities • Pursuit of in-school STEM learning opportunities. • Active inquiries into STEM topics, concepts or practices • Active information-seeking about mechanical or natural phenomena or objects
2. Youth develop capacities to productively engage in STEM learning activities	• Ability to productively engage in STEM processes of investigation • Ability to exercise STEM-relevant life and career skills	• Demonstration of STEM knowledge • Demonstration of STEM skills • Demonstration of an understanding of STEM methods of investigation • Demonstration of mastery of technologies and tools that can assist in STEM investigations • Demonstration of ability to work in teams to conduct STEM investigations • Demonstration of applied problem-solving abilities to conduct STEM investigations
3. Youth come to value the goals of STEM and STEM learning activities	• Awareness of STEM professions • Understanding the value of STEM in society	• Development of an understanding of the variety of STEM careers related to different fields of study • Demonstration of knowledge of how to pursue STEM careers • Demonstration of awareness that STEM is accessible to all • Demonstration of an understanding of relevance of STEM to everyday life, including personal life • Demonstration of awareness of opportunities to contribute to society through STEM • Demonstration of knowledge of important civic, global, and local problems that can be addressed by STEM

While the expert panelists achieved overall consensus on these outcomes and indicators, there were several interesting distinctions that have implications for both policy and practice:

1. There was shared agreement that afterschool STEM is best positioned to demonstrate its contributions to the following three indicators of learning in a clear rank order: Active participation in STEM learning opportunities; Curiosity about STEM topics, concepts or practices; and Ability to productively engage in STEM processes of investigation. There was also agreement about the ability to impact a second cluster of indicators of learning, ranked lower, that include: Awareness of STEM professions; Ability to exercise STEM-relevant life and career skills; and Understanding the value of STEM in society.

*This finding suggests two things. First that the afterschool field appears to be most confident about impacting indicators that relate clearly to the active **doing** of STEM learning activities (entailing participation, developing questions, and actively inquiring). The field is positive, but not in a clearly ranked order, about its ability to support a second set of learning indicators related to understanding the practices and value of STEM in society. Second, the field appears to be less confident in how afterschool programs demonstrate that they contribute to children's coming to value the goals of STEM and STEM learning, as the two indicators related to this outcome were ranked in the second cluster of six indicators.*

2. Experts in the afterschool field feel most confident that their work supports young people's interests, inquiries, and engagement with STEM activities. These are sub-indicators of progress toward STEM learning that can be seen and documented in immediate ways, within one afternoon for example. They represent an important dimension of learning as they are essential to laying the foundation for further participation in and study of STEM. The experts feel comparatively less confident in achieving other longer term outcomes such as youth demonstrating STEM knowledge, an understanding of STEM methods of investigation, and pursuit of further

in-school or out-of-school STEM learning activities.

The afterschool field's greater confidence in demonstrating more immediate learning indicators over longer term ones may reflect the uncertainty of attendance and other structural features that are an inherent part of the afterschool setting. Such features must be taken into account in policy measures intended to evaluate or direct the focus of afterschool STEM programs. The development of both short term and long term outcomes, and the relative contribution of afterschool, school, and other variables, may not be understood or articulated through current widely-used methods of evaluation and research, which focus on learning settings in isolation from one another.

3. When asked to rank their relative confidence in demonstrating children's progress towards the indicators of learning, all panelists included supporting children's development of STEM-relevant life and career skills in the second cluster of indicators. However, when asked to rank the sub-indicators in terms of those they felt best positioned to achieve, related sub-indicators such as the ability to work in teams or to apply problem-solving abilities to STEM investigations were among the top half of 17 sub-indicators ranked, with working in teams being the second most highly ranked of the 17.

The disparity between confidence levels in regard to achieving specific indicators of STEM-relevant skills (indicators associated with 21st century skills, which the afterschool field has embraced) and confidence about contributing to the larger construct of STEM-relevant skills suggests a possible lack of clarity about the relationship of discrete measurable outcomes (such as team work) and their relationship to essential dimensions of STEM literacy and practices.

4. When asked about the availability of assessment tools to document the consensus learning indicators, the study revealed that the afterschool STEM "supporters" (state and national education leaders and funders) are much more optimistic about the availability of such tools than the afterschool "providers."

This disparity suggests that there may be different standards for assessment between the two expert groups of panelists in this study. The provider group may either be unaware that tools exist or they may feel that they are not accessible or usable.

5. The sub-indicator "Pursuit of school STEM learning opportunities" garnered some of the least number of participants who felt highly confident the field could demonstrate this impact.

This finding is extremely important because to date many large scale studies of afterschool programs have used school achievement measures to assess the contributions of afterschool programs to children's learning and development. This consensus study found that the field believes it can make a contribution to children's pursuit of school STEM learning opportunities. However, it clearly communicated that among the list of 17 sub-indicators, this was one that they felt minimally confident about, and therefore would expect to see little demonstrated impact.

Recommendations

Based on the findings described here and more fully in the report, we make the following recommendations to advance afterschool as a strategic partner in STEM education:

1. **Policy Makers**: We recommend that policy makers consider the outcomes and indicators articulated in this study (described in Table A and the section on "Findings" in the full report) to define the appropriate niche for afterschool programs in STEM education. In particular, we note that the afterschool field has expressed reservations about its ability to impact school STEM outcomes but has expressed higher confidence in its ability to impact other skills such as problem-solving abilities, demonstrating STEM skills, career awareness and "21st century skills" such as team work. These latter skills are as important as academic outcomes for the longer term to broaden access and participation and to maintain an interest in STEM fields and careers. It is hense vital that STEM education policies reflect this understanding.

2. **Practitioners**: We recommend that program leaders utilize the framework of outcomes, indicators and sub-indicators articulated in this study (see Table A) to map out how their work contributes to STEM education overall. While it is not realistic to expect that each program will achieve all of the outcomes and indicators described in the study, it is important to set appropriate and feasible goals that reflect the strengths and constraints of each program. Utilizing outcomes and indicators from a common framework to describe a program's impacts will allow for aggregation of the impacts of the afterschool STEM field as a whole.

3. **Evaluation and Assessment Experts**: As noted earlier, there is a difference in perspective between the two groups of panelists in this study about the availability of assessment tools. We recommend that a group of evaluation and assessment experts, practitioners, and funders be convened to examine the status of available tools and map them to this framework of outcomes, indicators and sub-indicators. If tools are not available to measure some of these impacts, we recommend that this study's results be utilized to inform the design of new measures to assess afterschool STEM learning.

Areas for Additional Research

1. Based on the panelists' consensus that they felt more confident in documenting immediate rather than longer-term impacts, we recommend that the afterschool STEM field explore the development of new research and evaluation methodologies and instruments that can investigate STEM learning across settings, showing how immediate STEM learning outcomes in the afterschool setting relate to longer-term learning in the school setting, and vice versa. It may be only through such tools that the value and contributions of afterschool programs can be fully articulated and ultimately assessed. Indeed, this should be considered an area of investment and activity for the larger STEM education community and not just the afterschool STEM field.

2. We recommend that afterschool providers engage in a dialogue with STEM education leaders and researchers to more clearly articulate the relationship between discrete and measurable learning indicators or sub-indicators and the related overarching developmental STEM learning outcomes. This will help to clarify and resolve the apparent contradiction of expressing very low confidence in the afterschool STEM field's ability to achieve impacts as described by some indicators while expressing high confidence in the ability to achieve impacts described by sub-indicators related to that same indicator.

3. Finally, while the analysis did not detect statistical significance, we believe there are variations in perspective between the two groups of expert panelists included in this study and recommend further investigation to detect and resolve any real and meaningful differences between various stakeholders in afterschool STEM programs. Following up on this issue is sure to yield information about how to move the field forward to achieve its full potential and ideally provide a guide to funders as they seek areas for high-impact investments in the field.

Key Recommendations

Policy Makers
should utilize the outcomes and indicators described in this study to define the appropriate niche for afterschool programs in STEM education.

Program Leaders
should utilize the framework of outcomes and indicators described in this study to map out how their work contributes to STEM education overall.

Evaluation & Assessment Experts
should examine the outcomes and indicators described in this study and utilize its results to inform the design of new measures to assess afterschool STEM learning.

Afterschool programs are increasingly recognized as playing a valuable role in improving science, technology, engineering and mathematics (STEM) education.