The Frameworks for Next Generation Science Standards (NGSS) were published in 2012, and the standards themselves followed soon after. Much still remains to be done, however, to provide to all students, K-16, with high-quality, three-dimensional science education. The work is both timely and urgent: a science-literate populace is necessary for a functioning democracy, a vibrant economy, and a creative and engaged citizenry, in this time of ecological challenge and social turmoil.

The Carnegie Corporation of New York asked the National Academies of National Academies of Sciences, Engineering and Medicine (NASEM) to develop a Call to Action for Science Education, identifying strategic policy actions that could be taken at the national and state levels to expand and deepen the implementation of the NGSS at every level across the nation. It was Carnegie's judgement that such a call was needed at this time, because despite the urgent need to continue improving science education, science (and other STEM fields) were being overlooked in discussions of "learning loss" as a result of anti-COVID measures. Now also is an opportune moment, as the Biden presidency has made a strong commitment to evidence-based policy at all levels, and science literacy — for students and the general populace — is an important basis for the success of such policies.

The resulting Call to Action made several concrete recommendation in 3 major "action areas." Briefly, these are:

**Action Area 1: Elevate the Status of Science Education**
Recommendation 1: The White House, with leadership from the Office of Science and Technology Policy (OSTP), should act to raise the profile of science education and elevate the importance of access to high-quality science learning opportunities for all students across K-16.

Recommendation 2: Congress should include science as an indicator of academic achievement when it next reauthorizes the Elementary and Secondary Education Act.

Recommendation 3: State Departments of Education should act now to include science in their accountability systems for K-12 education.

Recommendation 4: National stakeholders in STEM education should undertake coordinated advocacy to improve science education K-16 with particular attention to addressing disparities in opportunity.

**Action Area 2: Establish Local and Regional Alliances for Stem Opportunity**
Recommendation 5: Leaders of local and regional K-12 systems and postsecondary institutions should work together to form Alliances for STEM Opportunity that involve key stakeholders in STEM education, such as informal education organizations, nonprofits, afterschool and summer programs, business and industry, and the philanthropic sector.
Recommendation 6: The federal government, philanthropic organizations, and business and industry should provide funding to support the work of local and regional Alliances for STEM Opportunity as they work to improve science education.

**Action Area 3: Document Progress Toward Better, More Equitable Science Education**

Recommendation 7: States should develop and implement data-driven state-level plans for providing equitable K-16 science, technology, engineering, and mathematics (STEM) education with specific attention to science.

Recommendation 8: The federal government should develop an annual “STEM Opportunity in the States” report card that documents the status of K-16 STEM education across each of the states and territories and tracks equity of opportunity for students in science and in each of the other STEM disciplines.

The STEMTLnet October Theme of the Month highlighted this Call to Action, and ways that it can be used by teacher leaders and others to strengthen K-16 science education. For the expert panel, Heidi Schweingruber, Ph.D., the director of the Board on Science Education at the National Academies of Sciences, Engineering and Medicine, served as the moderator. She was joined by Nancy Hopkins-Evans, the senior director of State Partnerships at Instruction Partners and Tiffany Neill, the Deputy Superintendent of Curriculum and Instruction for the Oklahoma State Department of Education. The panel also included a teacher respondent, Susan Meabh Kelly, a high school science teacher and PhD candidate who throughout much of her twenty year education career has collaborated with scientists in order to coordinate authentic science research experiences for urban high school students.

This Call does not stand on its own. NASEM has produced a series of milestone documents, starting with How people learn in 2000 (and its later companion volume), which made widely available in accessible form the results of cognitive and learning sciences research. Other volumes, including the Frameworks document itself, and additional reports on various aspects of formal and informal education, constitute a rich library of insight and guidance for educators, policy-makers, and the general public.

After Dr. Schweingruber gave an overview of the Call's origins and main points, panelists and participants were invited to share how they had made use of all the National Academies' reports to advocate or advance science education in their own work. These accounts of local action are essential in science education advocacy: as Nancy Hopkins-Evans reminded us, decisions about education, and science education, are local or regional, so this is the place where policies and practices get turned into reality. Since teachers are the critical agents in this work, science education advocacy also means advocacy for teacher preparation and life-long learning, done in an inclusive spirit. This entails real change in systems. Two posts in the chat accompanying the panel presentation picked up on this point energetically:

Wendi V: Pie in the sky for Teachers/administrators: redesign the work week/school week for time for teacher learning and collaboration, both with others in their district and communities, which includes families and non-traditional science orgs. Place matters.
Chelsea C: It is essential that we include shifts in mindset work along with skillset work into every professional learning session. Asking the tough questions about how the current system does not allow each and every student to thrive in science classrooms.

While some education commentators have recently downplayed the value or impact of the Frameworks, that was not at all the view that the STEMTLnet panelists or participants took. Tiffany Neill encouraged participants to speak about encouraging shifts that have taken place since the Frameworks. In fact, the chat was rich in encouraging testimonials about how participants had used the Frameworks and other NASEM documents in their leadership work.

Some examples:

- Jennifer B: I used the framework in every graduate level class ever
- Pam F: Used the Framework to revise our State Standards
- Emily M: I’ve used the Framework to help others understand what is appropriate for different ages to understand and know in the three dimensions.
- Kathy R: I have used those reports at the state level when I was state [working on] science assessment in Vermont. I continue to bring to use the reports in my work for the Wade Institute.
- Jeff W: I use the Framework to help explicate the standards with teachers
- Kathy K: Use the framework to revise scope and sequence
- Chelsea C: I have used excerpts from many of the texts shown in professional learning sessions with educators across TK-12. Starting with How People Learn and How Students Learn Math and Science.
- K. Renae P: I've used the NASEM reports as justification for science resources and support. Love throwing that research on the table.
- Betsy S: I direct our continual Community of Practice to know what research is available to them.
- Judie B: I use the Framework to help teachers understand the Science Standards.

Heidi Schweingruber then invited comment on ways to implement the recommendations of the Call, and recommended a strategy whereby anyone can find their way in to science education advocacy.

A first question might be, which actions or priorities do I think I'm most positioned to work on, or which ones are highest priority, from what I can see in my school, or my district, or my community? And then what can you do to advocate for that with a decision maker? And a local decision maker could just be a principal, [it] is anybody who can move a lever to make room for the learning that we want kids to have. So this is a rallying cry for all of us who care about good Science Education, and to think about, what are the advocacy actions you can take, or the steps you can take in your own sphere of influence?

How do we get involved in advocacy for science and STEM education? Where do we start? Tiffany Neill, in discussing state-level strategies, elaborated on Recommendation #8 with
the idea of "STEM opportunity maps," that track opportunities and gaps in what's available to students. She went on, "You as a teacher leader, as a district leader, you can start having these conversations, use the report to talk about some of these recommendations you're interested in, get people thinking about how this can happen, and you can move forward with that advocate advocacy."

Action area #2 stressed the importance of alliances, and reaching out beyond one's institutional base to collaborate, especially with researchers, who provide perspective on the changes or initiatives being undertaken in a school, district, or state, and help document them for the information and instruction of educators elsewhere. Susan Meabh Kelly remarked,

The recommendation that stood out for me, was the local and regional alliances for STEM opportunities ... I was thinking back at something that I had initiated a few years ago, across New York State. High School students participate in a three-year state university credit bearing high school science research program, and students design conduct, and communicate about authentic science research investigation...The result is often a university STEM major level research project, that's worthy of a state or national competition, such as the International Science and Engineering Fair. And through such opportunities, students can see themselves, and be seen as contributors to new STEM knowledge, and also gain some early insight into STEM career pathways. And so the outcomes of informal local and regional alliances, initiated by high school students and their teachers, demonstrate the potential of a connected STEM ecosystem.

The work is relational, and often local, but the experts on this panel, and the active participants voicing their ideas and experiences in the chat, show that whoever begins to get involved has allies across the country. Advocacy for science at every level will be strengthened by finding these allies and working with them on shared priorities. Tiffany Neill addressed a possible barrier to teacher-leaders who want to build such alliances, which is, "Where to get started?" She told participants

if...you're thinking, who do I get connected to, to form these alliances, who has the power to do this? I will say the best thing you can do is look in the mirror, because I believe it's you. If you don't know the person in your state in your area, it may very well be you. You have the expertise, you have the passion, it just takes a couple of crazy, crazy, crazy, crazy passionate people like you, to start a spark, to ignite a fire, and to work with informal science educators in your area or advocates, shareholders for STEM and Science Education.

**Recommendations for Teacher Leaders**

Teacher leaders should consider where the highest priority for improvement is for them within their local context, and relate that to advocacy their sphere of influence. The idea of an "opportunity map" could be used by teacher leaders and others in their community to understand strengths in the science education environment, and areas that need concerted attention.

Priorities that might be considered include:

- need for increased focus on elementary science (see slides)
- lack of materials, supplies, and space
• limited access to science courses for particular populations, especially in areas where the students are predominantly people of color, or in low-income areas (urban or rural)
• science education needs to receive more attention, and its benefits need to be highlighted within the school and the community, and especially among decision-makers
• alliances with educative resources outside the school can raise awareness and provide new opportunities for phenomenon-based, locally valued science learning

**Recommendations for administrators and policy-makers**
The panel mentioned 5 priorities for local science education, and it would be useful for local school leaders and their allies to consider which of these might apply in your context:

• Are there enough resources (e.g. time and materials) funding and attention?
• What steps are being taken to build a strong and diverse teacher force, with programs that treat teachers as professionals, and embed teacher PD as a permanent element in the local setting?
• What are you doing to create and maintain supportive pathways for students in science, e.g. apprenticeships/internships, or careful attention to transition from secondary to post-secondary?
• Are assessment and accountability aligned with the Frameworks vision, employing diverse methods and an emphasis on formative methods that can inform and improve classroom practice?
• How are you documenting how access is improved? How are you identifying gaps where students and resources are being lost from science and STEM pathways and opportunities?