NATIONAL ACADEMIES Sciences Engineering Medicine

Equity in K-12 STEM Education:

Framing Decisions for the Future

Report Release Webinar

NATIONAL ACADEMIES Sciences Engineering Medicine

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Statement of Task

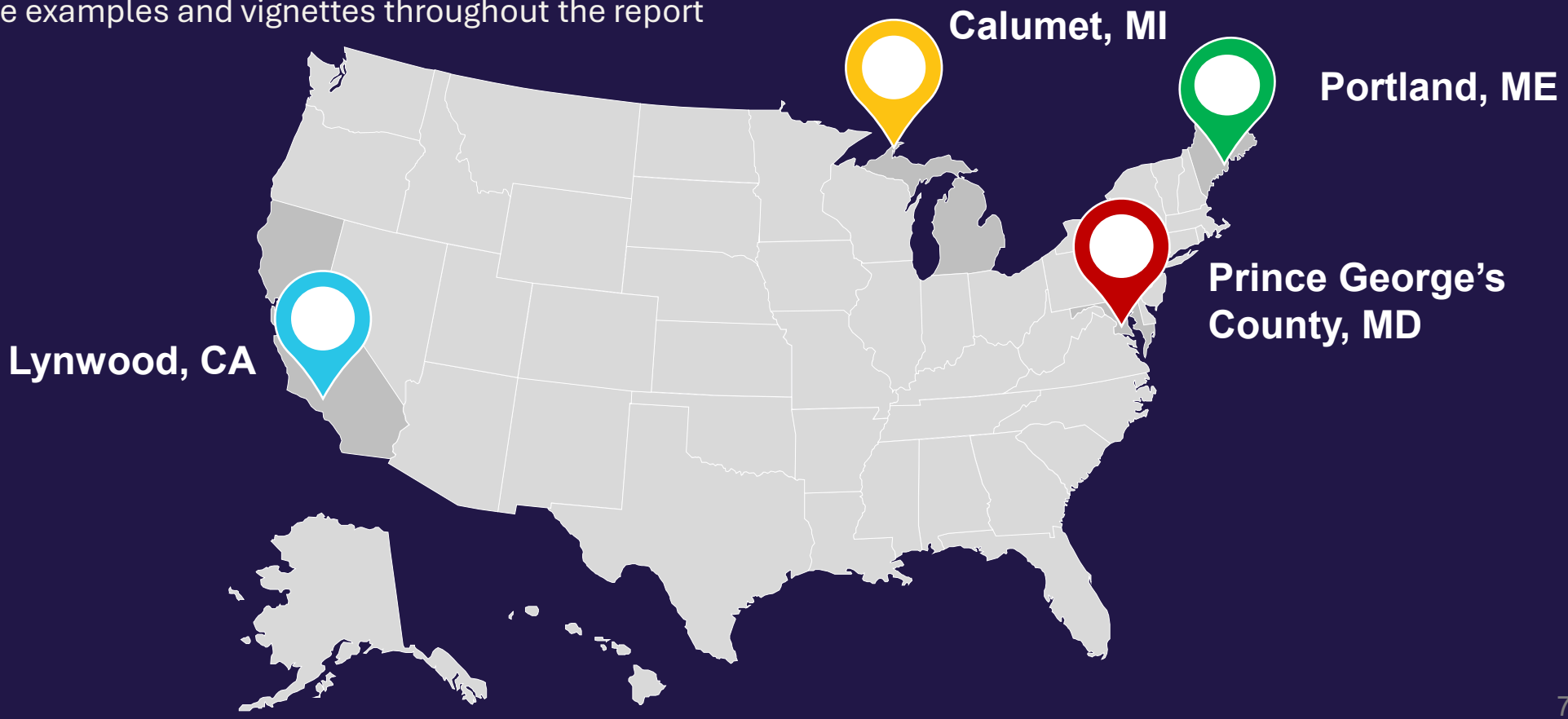
An ad-hoc committee of experts will examine the evidence base related to educational equity and STEM education, plan a series of regional field engagement sessions, and develop recommendations and a research agenda for the field. Based on peer-reviewed and grey literature, commissioned papers, input from the field engagements, and committee deliberations, the committee will write a consensus report that discusses how systemic inequity in STEM education can be addressed at all levels of the K-12 system to promote success in STEM for all students, regardless of background, demographic status, and community.

Statement of Task, cont.

- The committee will:
  - **Identify and describe inequity in the state of PreK-12 STEM education** in the U.S. and examine the evidence on explanations of and interventions to address those inequities.
  - Consider how **ongoing implementation of state-level science and mathematics standards can account for and address existing inequities** in such areas as resource and human capital distribution, course offerings, instructional approaches, family and community engagement, enrichment programs, access to technology and other concerns relevant to persistent inequalities reflected in the literature.
  - Review evidence on **policy and program interventions at the federal, state, district, and classroom levels** that have addressed equity concerns and might be promising practices
  - **Develop recommendations** for policy, practice and research to promote success for all students in PreK-12 STEM learning

Regional Field Engagements

- Regional field engagements helped the committee better understand the experience and challenges of educators working toward equity in STEM
- In engaging with this lived experience, the committee was able to contextualize our understanding of the evidence and leverage examples and vignettes throughout the report

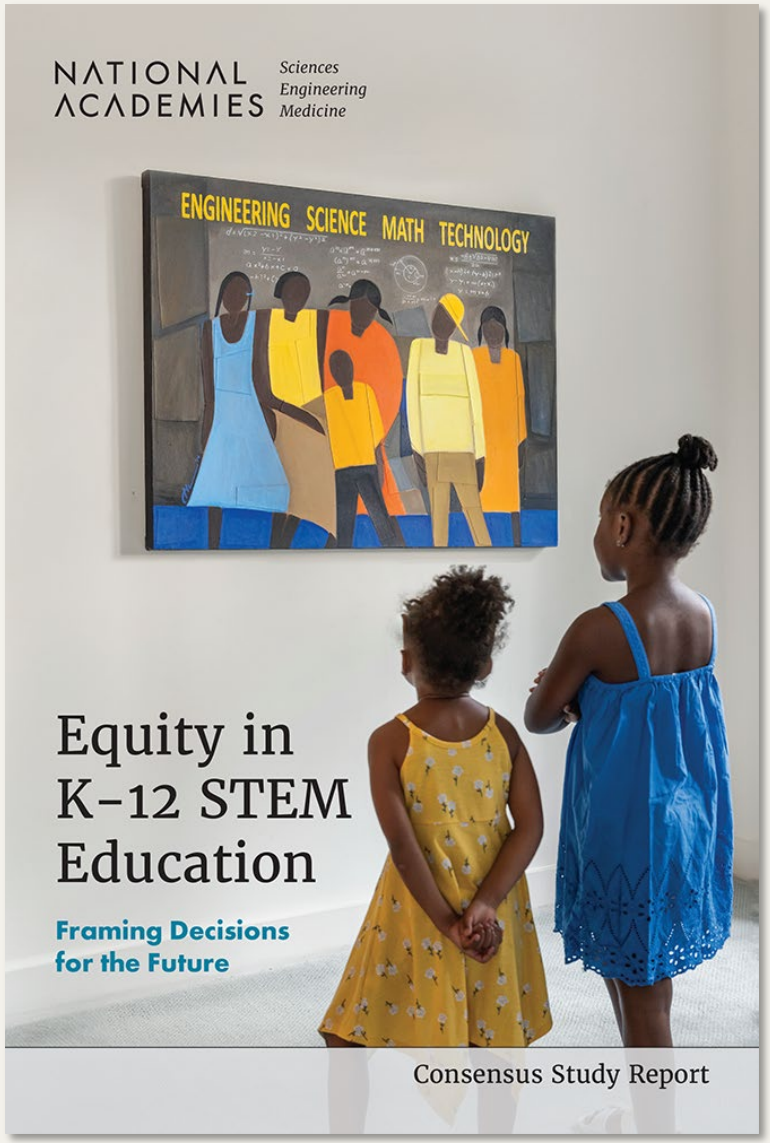


Report Arc

Defining the Problem and Context

Framing Equity and Decision Making

Decision Making Domains to Advance Equity



Report Chapters

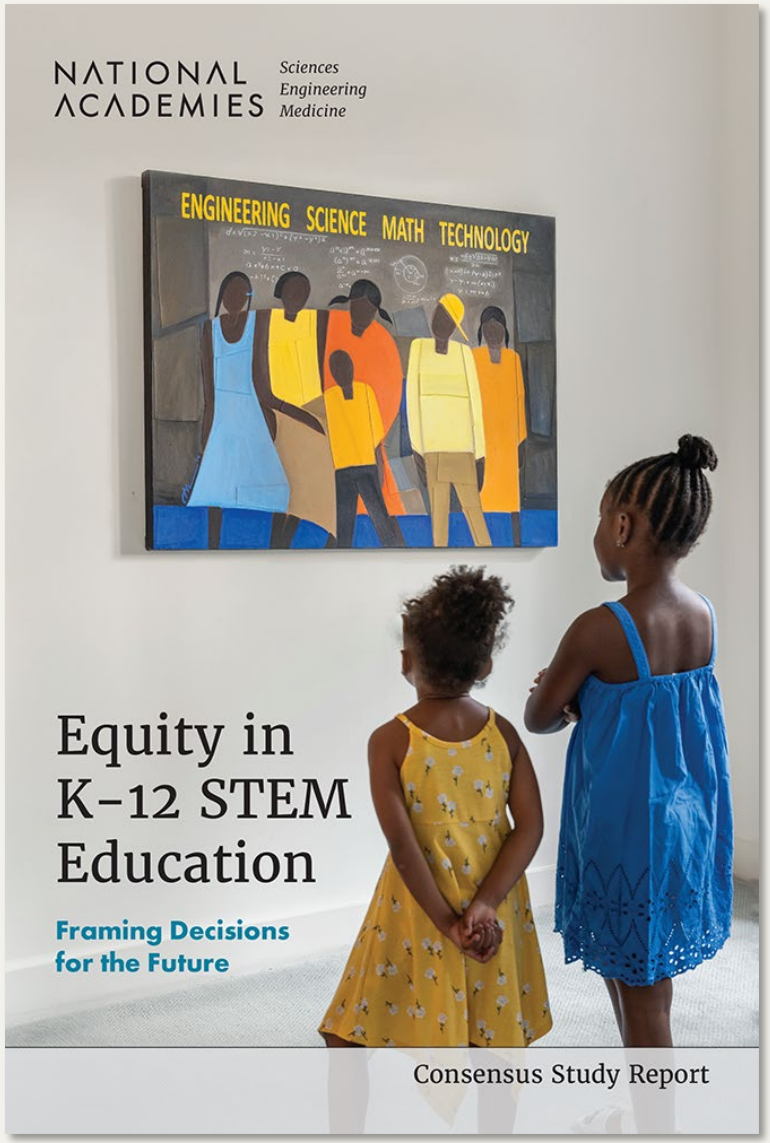
1 – Introduction

2 – History, Equity, and STEM Education
3 – Key Elements of the United States Education System
4 – An Overview of Broad Patterns of Inequality in PreK-12 STEM Educational Outcomes
5 – Children and Youth

6 – Approaches to Equity through the Lens of Decision Making: Five Frames

7 – Learning in STEM
8 – Teaching for Equity in STEM
9 – Developing Teaching Practices toward Equity
10 – Instructional Materials, Time and Resources
11 – Supporting Equitable Pathways in STEM Learning

12 – Vision, Recommendations, and Future Research

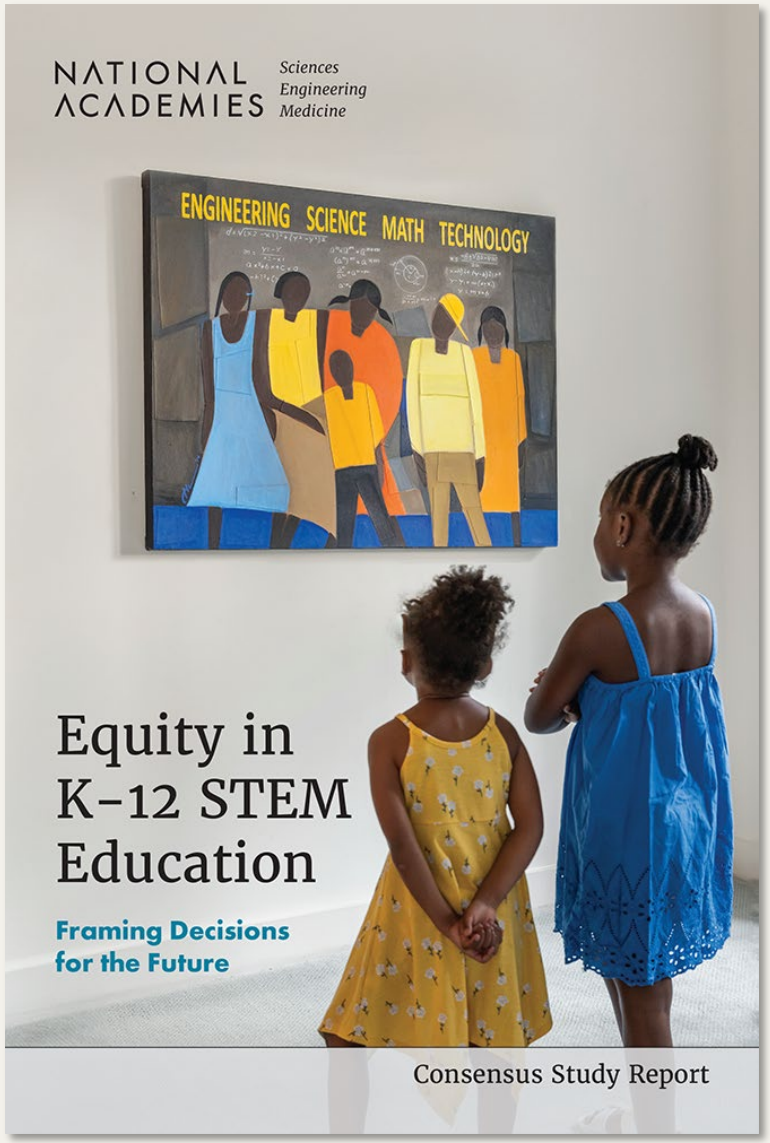


Cross-Cutting Themes

Shifting from Deficit to Asset

Broadening the Purposes of STEM Education to Go Beyond Workforce

Partnering with Families and Communities



Defining the Problem and Context

Essential Elements Impacting Equity in STEM Education

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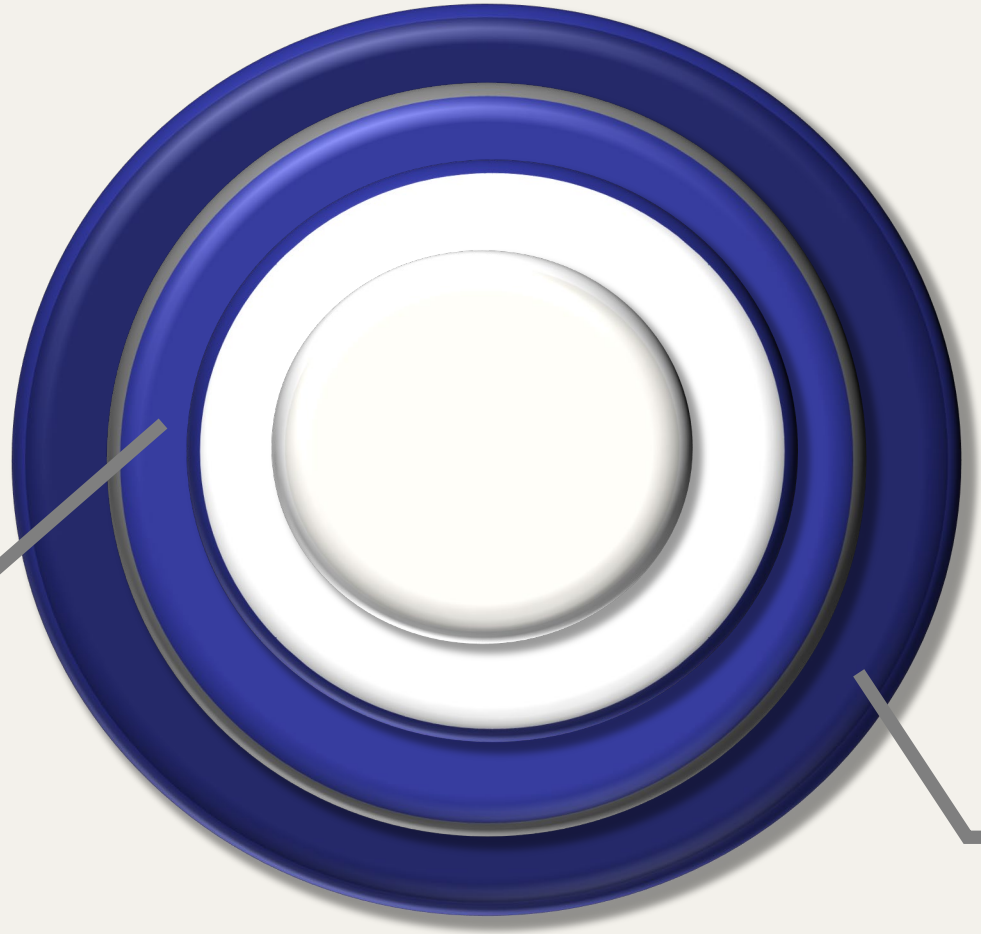
Conclusions: Historical and Policy Contexts



The education system operates at multiple levels. Key domains for policy change and action operate across these levels

Development of a STEM workforce has dominated policy discussions related to STEM education

STEM education has operated to maintain the status quo, but communities have found and created openings for pursuing opportunity

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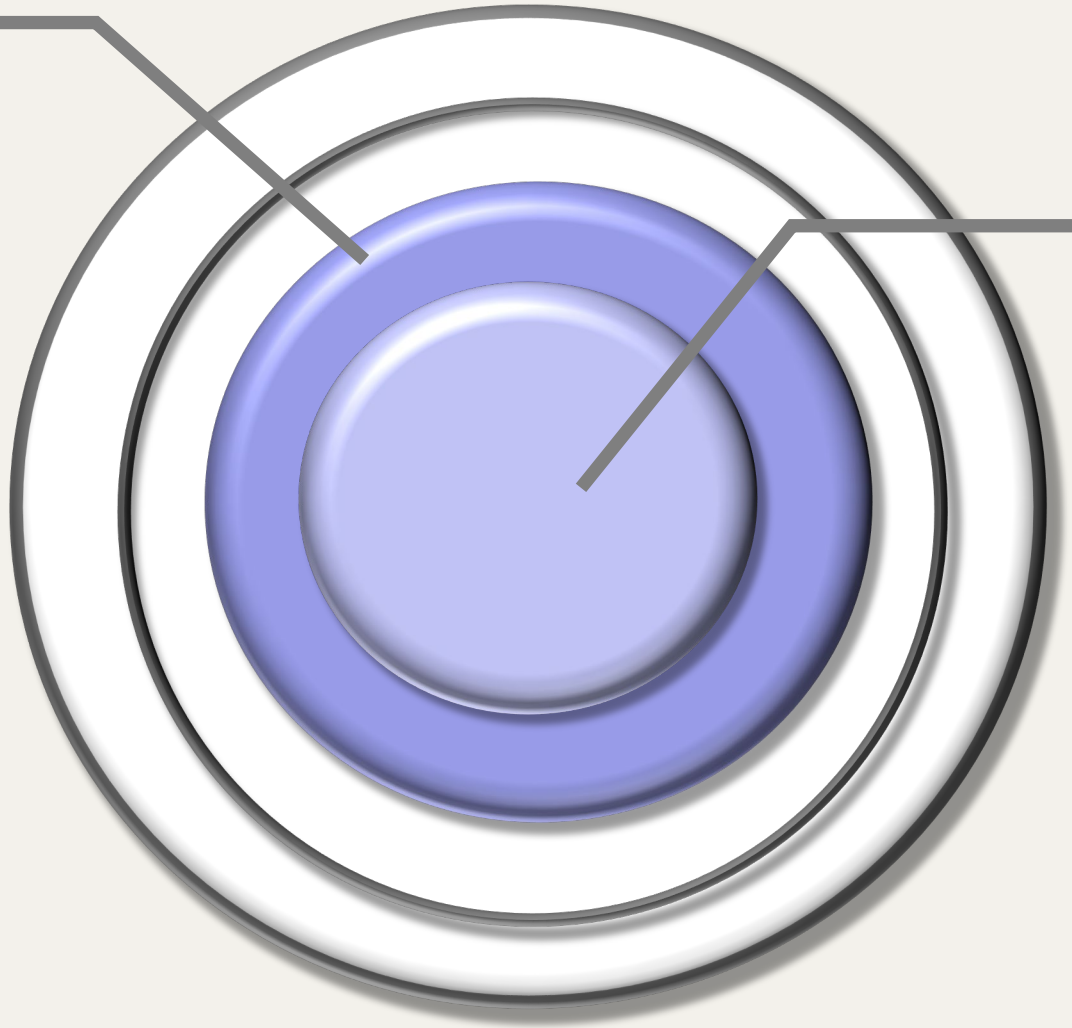
Conclusions: Current State of STEM and Lived Experience of Children and Youth

There are persistent inequities in outcomes and opportunities and an over-reliance on achievement as a sole indicator



Moment to moment interactions in STEM learning contexts shape the lived experiences of children and youth with consequences for how they see themselves in STEM

CONCLUSIONS: Historical and Policy Contexts

Framing Equity and Decision Making

Framing Decisions for Equity in STEM Education

1. Reducing Gaps between Groups
2. Expanding Opportunity and Access
3. Embracing Heterogeneity in STEM Classrooms
4. Learning and Using STEM to Promote Justice
5. Envisioning Sustainable Futures through STEM

All actors in education systems have a role in advancing equity through their decisions and actions

Recommendation 1:

Stakeholders at all levels of the education system—including state, district and school leaders and classroom teachers—**all have roles as decision makers who can either advance equity or allow inequities to remain in place.** Using the five equity frames as a guide, **decision makers should articulate their constituents' and their community's short- and long-term goals for equity** and then make decisions about policy and practice oriented toward those goals.

Decision Making Domains to Advance Equity

Decision Making Domains

Learning and Instruction

Supporting Educator Learning

Instructional Materials

Pathways and Opportunities

Recommendation 2

State, district, and school education leaders and decision makers across both in- and out-of-school spaces should develop strategic plans for advancing equity in STEM education. These actors should:

- Ensure that the specific histories and cultural contexts of impacted communities are represented in the decision-making process through intentional partnership and engagement.
- **Establish mechanisms for input and feedback from impacted community members.**
- **Conduct an initial "equity audit"** to identify patterns of inequity and to aid in prioritizing investments and changes in policy and practice.
- **Articulate the relevant outcomes to track** and design strategies to reach them.
- **Collect ongoing data to document progress** toward equity goals and inform ongoing improvement efforts.
- **Identity problematic or harmful policies and practices** and revise decisions as appropriate.

Learning and Instruction

Learning and Instruction

- STEM-related learning occurs across multiple contexts and is shaped by cultural, social and political contexts. All forms of STEM knowledge are not typically recognized in formal STEM learning contexts

- New, evidence-based approaches to STEM learning and teaching open up productive spaces for advancing equity

- Instruction that advances equity in STEM engages students in the concepts and practices of the disciplines, leverages learners' assets and centers their competence as sense-makers

Recommendation – Learning and Instruction

RECOMMENDATION 6: In order to shift instruction in ways that advance equity in STEM classrooms, **STEM educators** in school and in out of school settings should:

- **Reflect on and interrogate routine instructional practices in STEM** for how they may be providing (or limiting) opportunities for learners based on learners' social identities.
- **Implement instructional approaches in STEM that draw on asset-based perspectives**, center students' sensemaking as tied to their cultural and socio-political worlds, and frame STEM practices and knowledge as dynamic, evolving, and connected with other disciplines both within and outside of STEM.
- Work to **recognize and disrupt inequities as they emerge in the classroom**, including between students.
- Identify and **leverage STEM resources in students' families and in the surrounding community**
- When possible, **join or establish professional learning communities** within and across schools and districts in order to learn from and support each other.

Supporting Educator Learning

Supporting Educator Learning

- High quality professional development is essential for advancing equity-oriented teaching in STEM
- Educators' interactions with colleagues, administrators, and others are important contexts for advancing equity

Recommendations – Supporting Educator Learning

RECOMMENDATION 7: High-quality, sustained professional learning opportunities are needed to engage teachers as professionals with effective, evidence-based instructional practices in STEM that advance equity. **Such opportunities should provide support for teachers to reflect critically on their own instruction in STEM and try out new approaches in an iterative process over time.**

- **Designers and providers of professional development** and coaching should design and implement professional learning experiences that draw on research-based models for advancing culturally responsive and sustaining instruction in STEM.
- **Individuals with responsibility for selecting professional development providers** (district administrators and other district leaders, school leaders) should develop rubrics for identifying high quality professional development providers who can support teachers in developing equitable instructional practice and provide resources for teachers to engage in professional learning related to equity in STEM.
- **School leaders** (principals and instructional coaches) **should allocate space, time and support for teachers to engage in professional learning related to equity in STEM** through both formal professional development experiences and through professional learning communities.

Recommendations – Supporting Educator Learning

RECOMMENDATION 8: Teacher educators should provide pre-service teachers with opportunities to:

- learn about the history of inequities in STEM and in STEM education,
- reflect on their own experiences with and identities in STEM,
- become familiar with culturally responsive and sustaining instructional approaches, and
- implement equitable instructional approaches in STEM in settings where they can reflect on and improve their own instructional practice.

Instructional Materials

Instructional Materials

- Instructional materials can play a role in reinforcing narrow conceptions of STEM disciplines and whether students' identities and experiences outside of school will be recognized and leveraged as assets

Recommendations – Instructional Materials

RECOMMENDATION 10: In designing STEM curriculum, **designers and developers of curricular and instructional materials should**:

- **Include a diversity of designers** (considering disciplinary perspectives, race, gender, ability, language, sexual orientation, geography) **on their teams** who share power and authority in the design process.
- **Align materials to evidence-based instructional approaches** in the STEM disciplines
- **Include a variety of modalities and ways of developing STEM knowledge** and understandings that reflect diverse ways of knowing the natural and designed world through STEM.

Recommendations – Instructional Materials, cont.

RECOMMENDATION 11: State, district or school level actors who are responsible for the selection, adoption, and implementation of curricular and instructional materials **should leverage evidence-based rubrics for evaluating how well potential materials align to stated goals for equity in STEM**. Among other criteria, state level actors should ensure that materials:

- are aligned to evidence-based instructional approaches in the STEM disciplines,
- support instructional approaches that leverage culturally appropriate/sustaining pedagogy,
- include a range of asset-based examples from different cultural contexts, and
- integrate features that are educative for teachers.

RECOMMENDATION 12: State, district and school leaders who are responsible for guiding the selection and adoption of instructional materials should:

- **Include criteria related to equity when selecting instructional materials in STEM.**
- **Use rubrics and measures of curriculum implementation to evaluate whether STEM learning opportunities are equitable** across schools and grade levels within their districts.
- **Draw on resources in the community in developing and adapting STEM curriculum** and instructional materials.

Pathways and Opportunities

Pathways and Opportunities

- There are barriers built into current systems that can limit STEM learning opportunities
- Building equitable pathways involves individuals as well as creating supportive systems

Recommendations – Pathways and Opportunities

RECOMMENDATION 13: In realizing a vision for equity in STEM**, state-level actors** (such as state superintendents, state department of education staff, legislators and governors) **should review how state level policies**, including those related to resource allocations (e.g., school finances, distribution of highly qualified educators) **need to change to build equitable STEM pathways**. This could include attention to policies related to district and school funding formulae; assessment; course access, placement and sequencing; graduation requirements; and instructional time. **This review should attend to how these policies may contradict or work in concert with each other and toward addressing inequities or reproducing them**. Specifically, state-level actors should:

- Examine state-level expectations for minimum instructional time across grade levels so that all students have access to instruction in the STEM disciplines.
- Engage with multiple sources of evidence (such as student experience, etc.) in supporting the development of policies that inform course placement and pathways.
- Examine resource allocations in relation to need

Recommendations – Pathways and Opportunities, cont.

RECOMMENDATION 14: District and school administrators should consider ways to modify or eliminate course and program placement policies that limit students' access to advanced coursework and programming. Where policy changes are made, administrators should develop communication strategies to explain the changes and devote resources to building the capacity of teachers, school staff (e.g. guidance counselors), and families to help them understand, support, and enact the policy changes.

RECOMMENDATION 15: District and school administrators should allocate sufficient time for elementary-level instruction in the STEM disciplines, including science.

RECOMMENDATION 16: Guidance counselors, teachers, and school administrators, and out of-school educators/mentors should attend to a broad array of student strengths and capacities (rather than test scores and grades alone) when guiding and advising students toward STEM futures.

Cross-cutting Recommendations

Recommendations – Partnering with Families and Communities

RECOMMENDATION 9: Advancing equity in STEM requires recognition of the assets of families and communities, and investments in the development of mutually beneficial partnerships between schools, districts, families and communities.

- **District and school leaders should develop strategies for engaging with families and communities** that deepen leaders' understanding of local context and history, build channels of communication, and nurture mutual respect.
- **District and school leaders should allocate time and resources for teachers to build relationships with families and communities** to allow them to deepen their understanding of local context and history and help them to appreciate and leverage family and community assets in STEM instruction.

Recommendations – Investments for Advancing Equity

RECOMMENDATION 17: To support equity in STEM education, **funders of Prek-12 educatio**n such as philanthropic organizations, government agencies and business and industry, **should**:

- **Provide resources for the development of STEM instructional materials and associated professional learning materials for teachers that include attention to equity** and are designed with robust conceptions of equity at the center
- **Prioritize funding proposals for STEM education programs that identify a specific vision of equity, articulate a clear plan for how the project will achieve its equity goals, and centers equity throughout the project design.**
- **Expand how projects can demonstrate success** to include measures that go beyond narrow definitions of student achievement.
- **Support investigation of systems-level change initiatives to promote equity**, beyond a focus on programs that seek to impact individual learners

Recommendations – Assessment

RECOMMENDATION 3: In pursuit of assessment systems that support a vision of equity in STEM education, **state departments of education should**:

- **Establish new metrics for equity in STEM that** are supported by research and **go beyond student achievement**, such as measurements of student experience and resource allocation related to those experiences.
- **Develop systems approaches (e.g., portfolio-based approaches) to measuring the performance of districts, schools, and educators** that reflect multiple measures beyond student achievement.
- **Develop assessment policy that leverages the expertise and judgment of educators**, while also developing their capacities, and enacts wider, more substantive views of student achievement.

RECOMMENDATION 4: In consultation with leadership from the state level, **district leaders should implement balanced assessment systems** that leverage multiple measures of equity in STEM beyond student achievement.

Recommendations –Data

RECOMMENDATION 5: Data on students' learning opportunities and allocation of time and resources provide important information to guide education leaders and decision-makers as they work to advance equity in STEM education. **Districts should develop data systems that capture information about opportunity to learn including time for instruction, allocation of resources and funding, access to and enrollment in STEM courses, and qualifications and characteristics of teachers.** These data should be disaggregated to examine trends for sub-groups of students (e.g. race, ethnicity, gender, socio-economic status, disability status, language) and by school characteristics.

Research Agenda

Research needs to be designed, conducted, and interpreted with equity at the center

Historical and Conceptual Background

- *Additional research in this area could help to illuminate the systemic and structural nature of inequity and to inform strategic action moving forward*

Policy and Decision Making

- *Research in this area can support actors in making strategic decisions aligned to their equity goals*

Policy Domains

- *Within specific policy domains, research is needed to help actors design, implement, and evaluate how decisions work at all levels of the public education system*

Questions and Discussion

Thank you for your engagement!

If you're interested in reading the report, you can obtain a PDF (for free!) or order the book at nap.edu —
search for *Equity in K-12 STEM Education*