

NATIONAL
ACADEMIES

*Sciences
Engineering
Medicine*

Science and Engineering in Preschool through Elementary Grades

The Brilliance of Children and the Strengths of Educators

Available at: www.nap.edu {search Brilliance and Strengths}

Norms for Participation

Strive to promote an inclusive environment where everyone feels welcomed, valued, respected, and supported

- Embrace diversity
- Be open, listen respectfully
- Be constructive in your comments
- Remember, bullying behavior will not be tolerated
 - If you see any unwelcomed behavior and you feel comfortable to, call it out
 - Let a National Academies staff member know

Virtual Participants:

Chat is enabled and you are encouraged to actively engage with participants. Questions for the panelists/moderators need to be entered into the Q&A box.

In-person Participants:

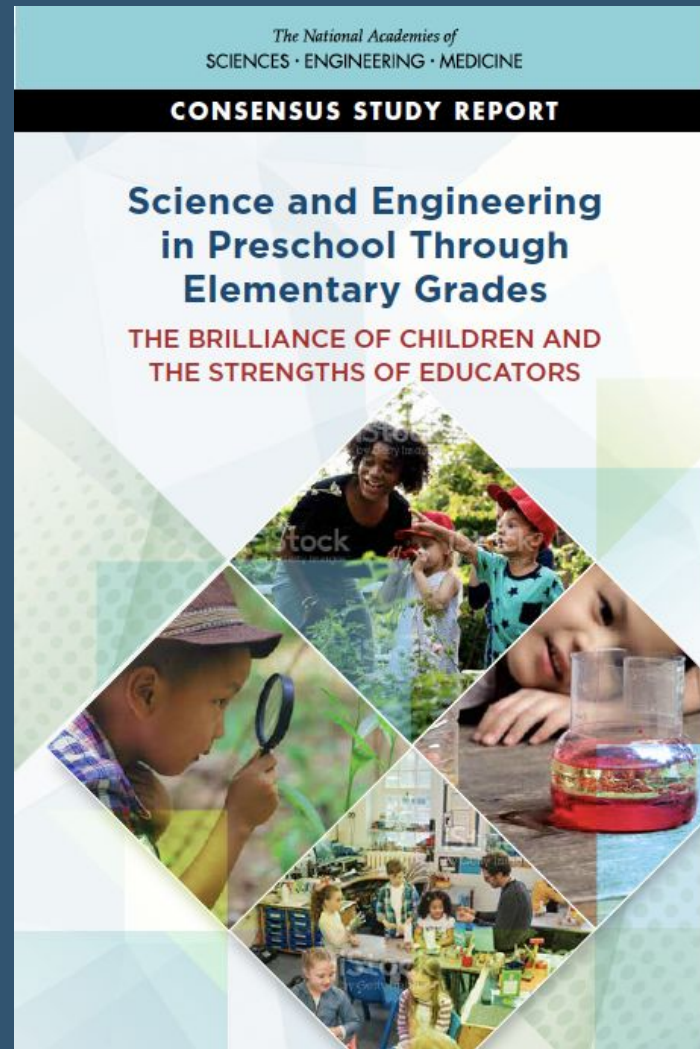
Please come to one of the mics.

Share on Twitter #BrillanceAndStrengths

Agenda

1	5
Brief Report Overview	Lunch/Break – About 1 hr
2	6
Learning in Practice	Policy, Practice, and Leadership
3	7
Break – 15 min	Sponsor Reflections
4	8
Designing Curricular Materials	Adjourn

Brief Report Overview



01

BOARD ON SCIENCE EDUCATION

Science and Engineering in Preschool through Elementary Grades: The Brilliance of Children and the Strengths of Educators

 *#BrillianceAndStrengths*

Sponsors:

Carnegie Corporation of New York
Robin Hood Learning + Technology Fund

Charge

Provide guidance on effective approaches to science & engineering instruction in PreK-5 that support success of all students.

- learning experiences prior to entering school
- promising instructional approaches
- integration of science & engineering with other subjects
- role of curriculum & instructional materials
- professional learning opportunities
- policies & practices at the national, state, & local levels
- gaps in the current research base



Committee and Study Staff

COMMITTEE

ELIZABETH A. DAVIS (Chair)

University of Michigan

HEIDI CARLONE

Vanderbilt University

JEANANE CHARARA

SOLID Start, Michigan State University

DOUGLAS CLEMENTS

University of Denver

KATIE MCMILLAN CULP

New York Hall of Science

XIMENA DOMÍNGUEZ

Digital Promise

DARYL GREENFIELD

University of Miami

MEGAN HOPKINS

University of California, San Diego

EVE MANZ

Boston University

TIFFANY NEILL

Oklahoma State Board of Education

K. RENAE PULLEN

Caddo Parish Public Schools, Shreveport, LA

WILLIAM SANDOVAL

University of California, Los Angeles

ENRIQUE SUÁREZ

University of Massachusetts

CARRIE TZOU

University of Washington, Bothell

PETER WINZER (NAE)

Nubis Communications

CARLA ZEMBAL-SAUL

Pennsylvania State University

STUDY STAFF

AMY STEPHENS

Study Director

MARGARET KELLY

Senior Project Assistant

TIFFANY TAYLOR

Program Officer

HEIDI SCHWEINGRUBER

Director, Board on Science Education



Why science and engineering for every child?

- Oriented to the future
 - Solid foundation (enthusiasm & knowledge) for later success
 - Become informed decision-makers
 - Access to high-paying STEM-related jobs
 - Involvement of broader range of identities and backgrounds
- Oriented to the present
 - Deserve to experience wonder of science and satisfaction of engineering
 - Children deeply curious about the world
 - Opportunities to ask and answer authentic questions and solve real-world problems that are important to them

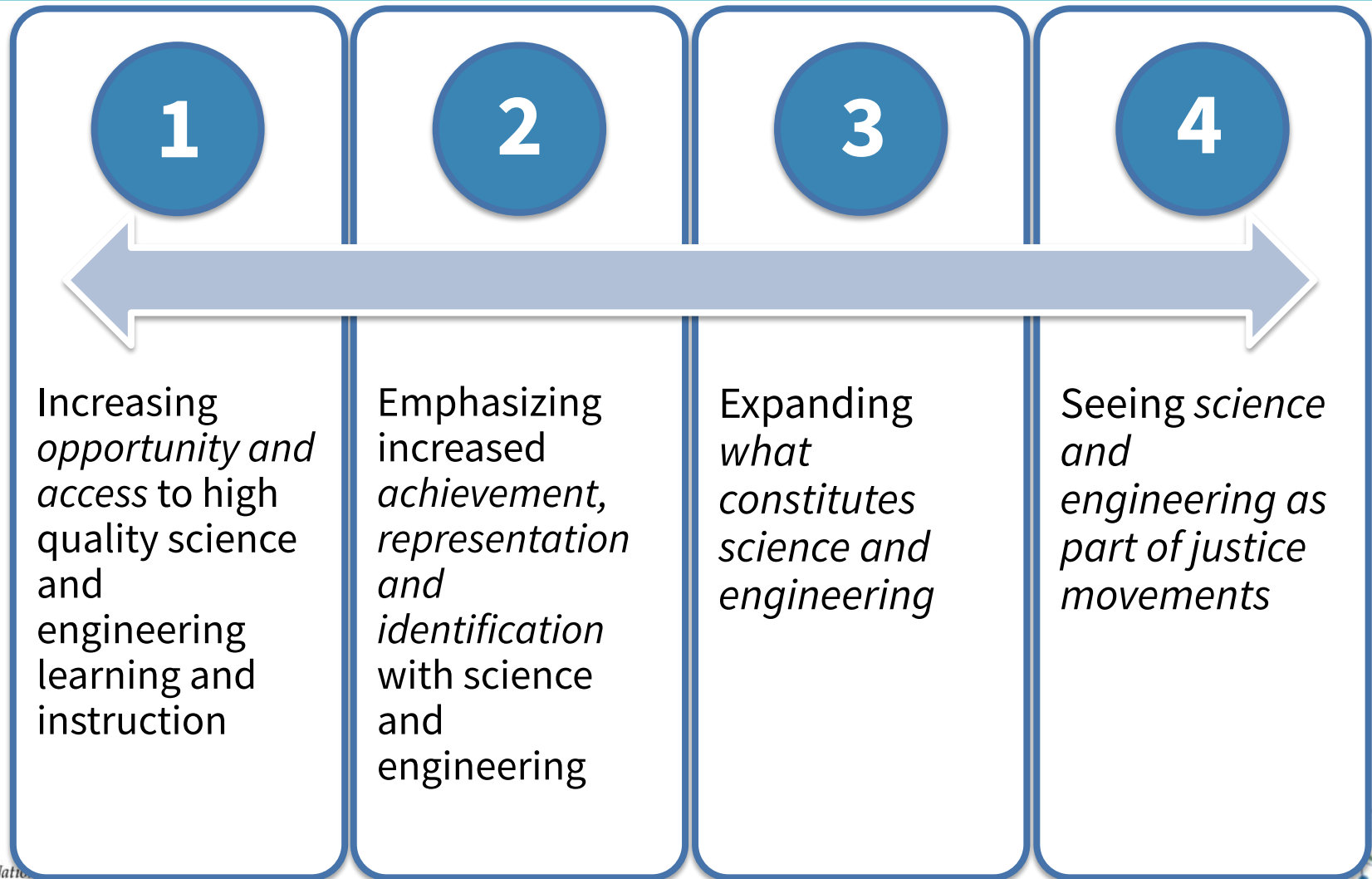


The Committee's Commitments

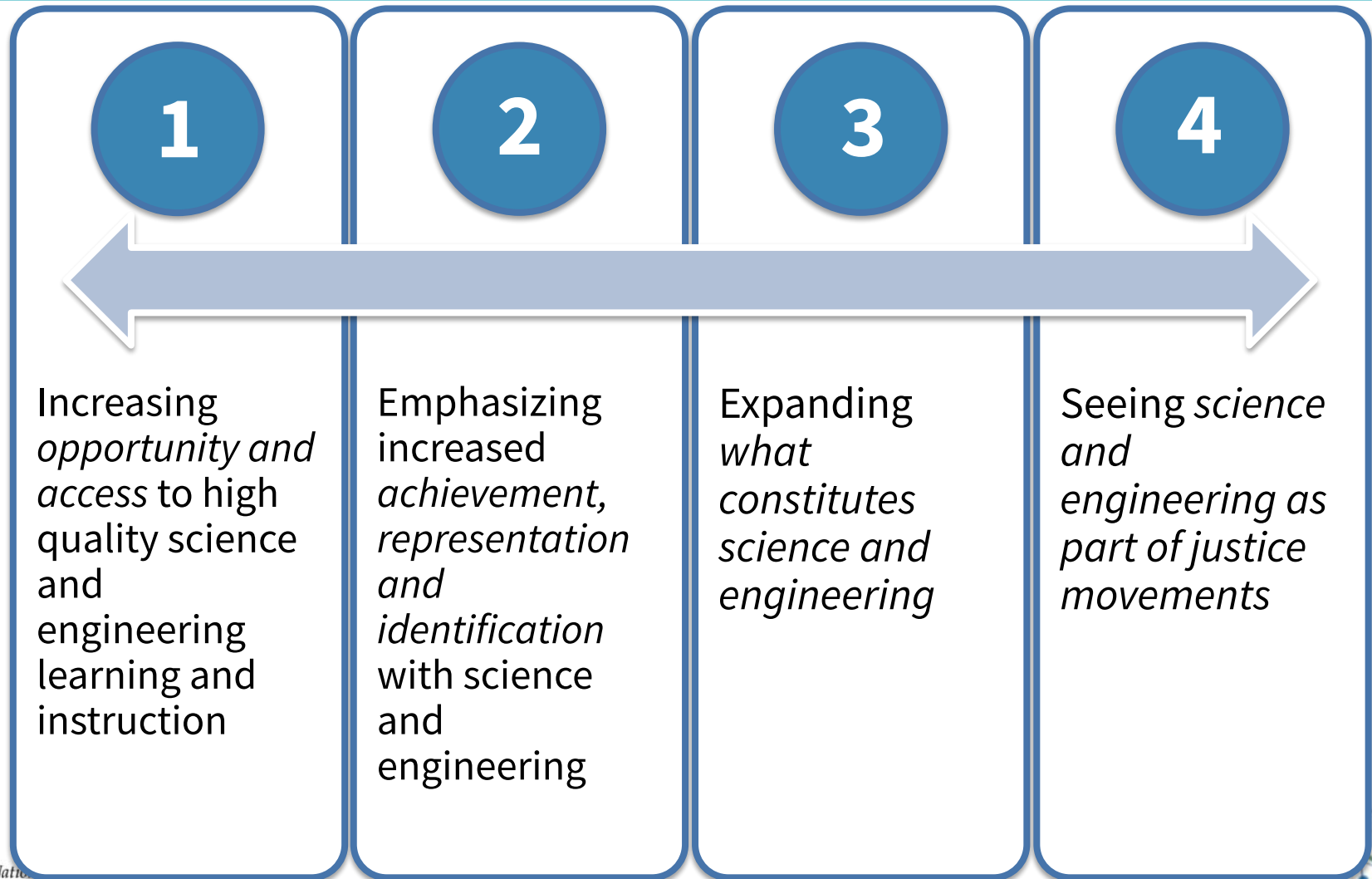
- Acknowledge that science and engineering are not neutral
 - Situated within complex historicized system
 - Antiracism and justice central elements of educational system that works to redress social inequities and oppressions.
- Recognize strengths of children, communities, families and educators
 - Use asset-based language in describing these actors & settings.
 - Attend to how learning environments could draw on, build, and attend to these strengths and needs.
- Hold vision for science and engineering learning as intentionally bringing together science and engineering practices, disciplinary core ideas, crosscutting concepts, identities, and interests.



Four Approaches for Equity and Justice



Equity and Justice: A High-Level Synthesis Across Report



Equity and Justice: 1 - Opportunity and Access

1

Increasing
opportunity and
access to high
quality science
and engineering
learning and
instruction

- Biggest issue is **instructional time**. Lack of resources, particularly in schools that serve larger proportions of children of color, also negatively affects opportunity and access.
- Drawing on children's **cultural and linguistic resources** can give a broader range of children opportunity and access.
- Leaders **set up the conditions** that allow science and engineering to be taught well in schools.

Equity and Justice: 2 - Achievement, Representation, and Identification

1

2

3

4

- **Educational policies** aimed to increase achievement in reading & mathematics have had unintended effect of decreasing children's opportunities to learn science.
- Helping children **orient to meaningful phenomena & design challenges** & developing classroom culture oriented toward **collective well-being & knowledge building**, may help them engage more fully in sensemaking & develop their identities as people who do science and engineering.
- Texts & curriculum materials can **increase representation**, allowing broader range of children to "see themselves" in science/engineering. Diversifying teacher educator workforce can help preservice elementary teachers see themselves as people who can teach science.

Equity and Justice: 3 - What Constitutes Science and Engineering

1

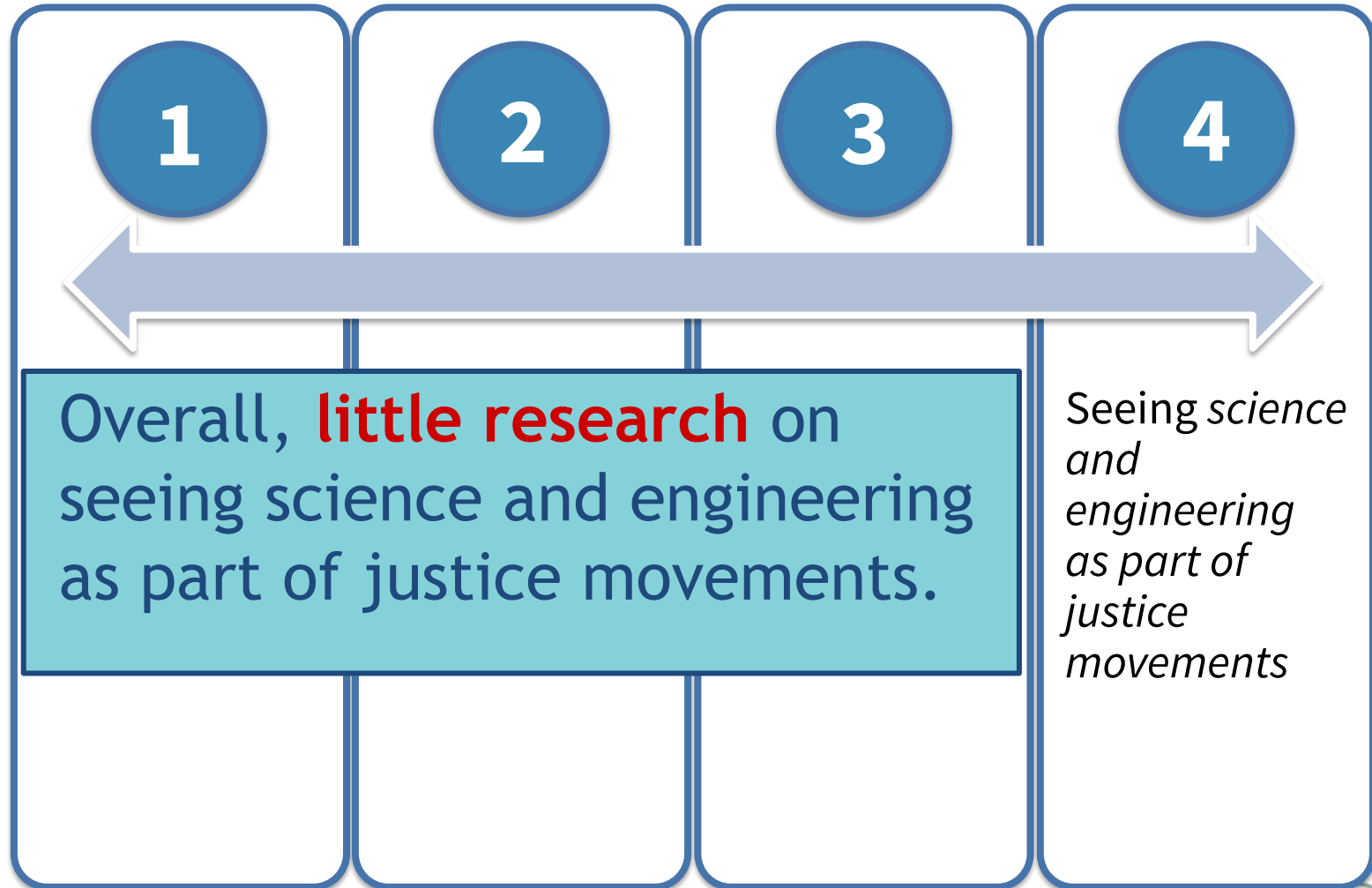
2

3

4

- Systems can **reify status quo**. Principals can support shifts in perspectives on what constitutes science/engineering.
- Expanding how science/engineering **discourses** are defined & **connecting to families and places** can help develop more expansive perspective.
- By failing to recognize science/engineering in **what children say or do**, educators may fail to leverage rich opportunities to learn.
- **Expanded vision of science/engineering practices** helps to demonstrate the strengths Indigenous children or other children of color bring to science and at the same time, extends all children's perspectives about what constitutes science.

Equity and Justice: 4 - Part of Justice Movements



Prioritizing Science and Engineering in Preschool through Elementary Grades

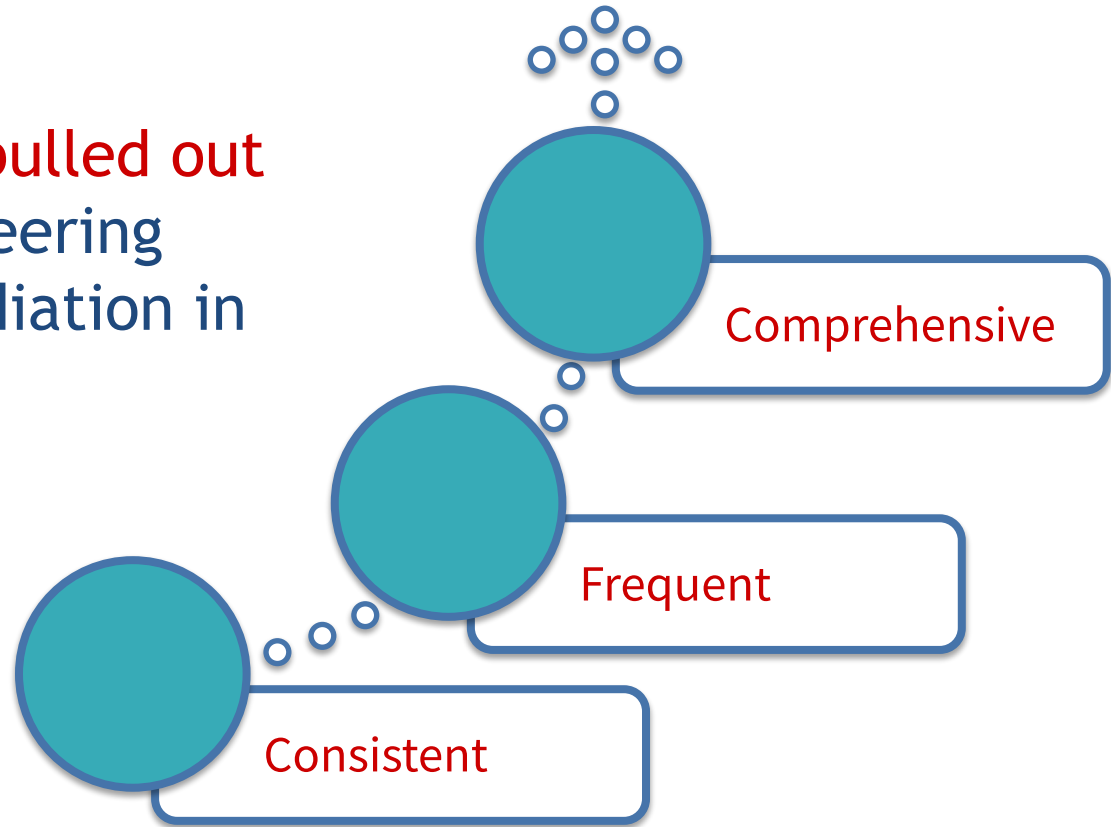


State Policymakers should

Ensure **children not pulled out** of science and engineering instruction for remediation in other subjects.

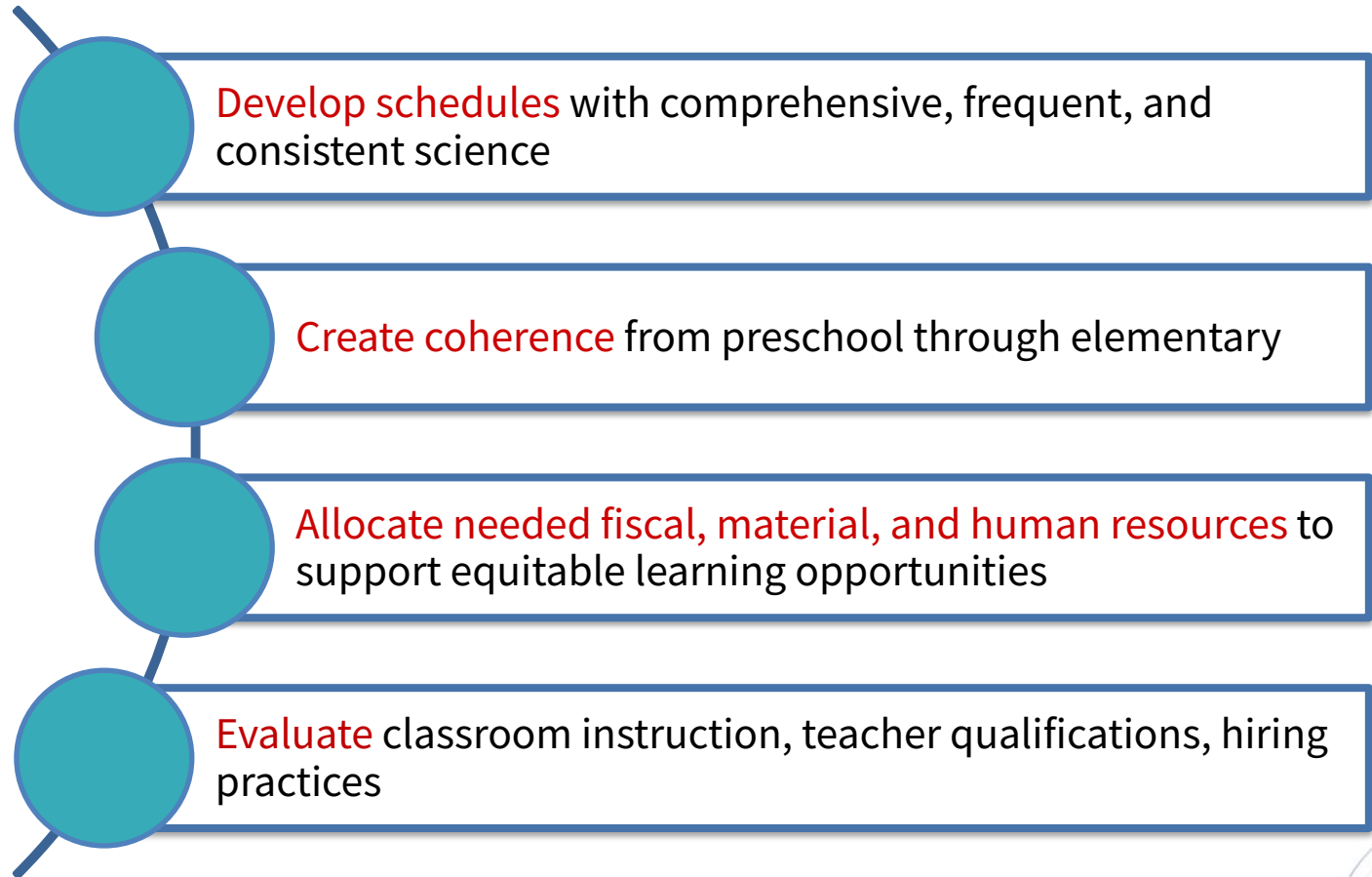
Establish policies for schedules

Science and Engineering



Recommendation 1

District and School Leaders should



Supporting Children's Learning and Proficiency



What Can Teachers Do

Arrange instruction around phenomena and design problems

Enact learning experiences that establish norms for a caring, collective culture

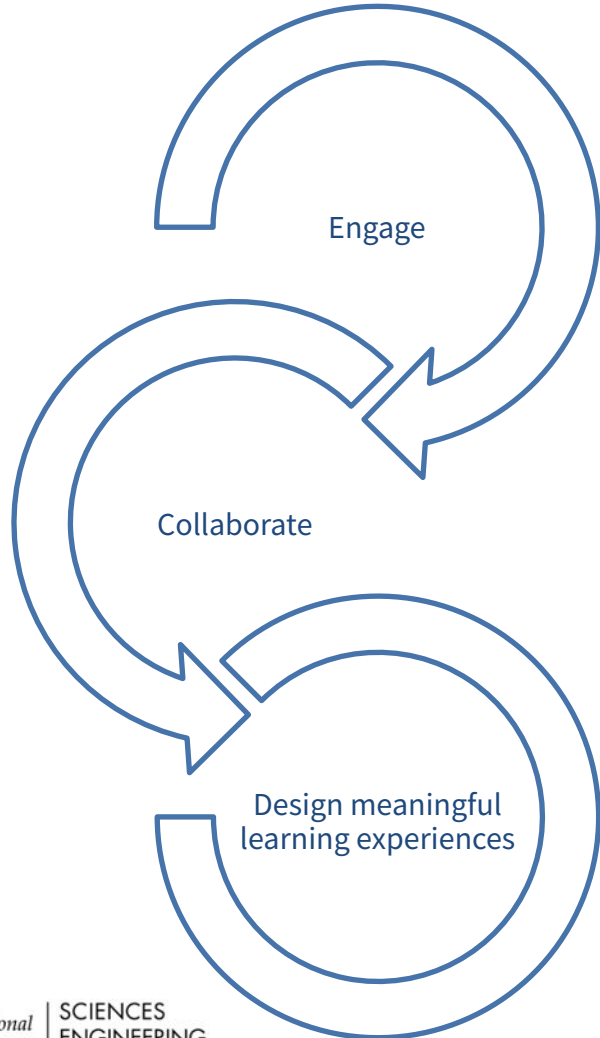
Position children as active thinkers and doers

Include formative assessment processes that gather multiple forms of evidence at multiple timepoints

Seek opportunities to continue to build expertise in working toward equity and justice



Preschool and Elementary School Leaders and Teachers should



Engage and collaborate with families and local community leaders to mutually support children's opportunities for engaging in science and engineering.

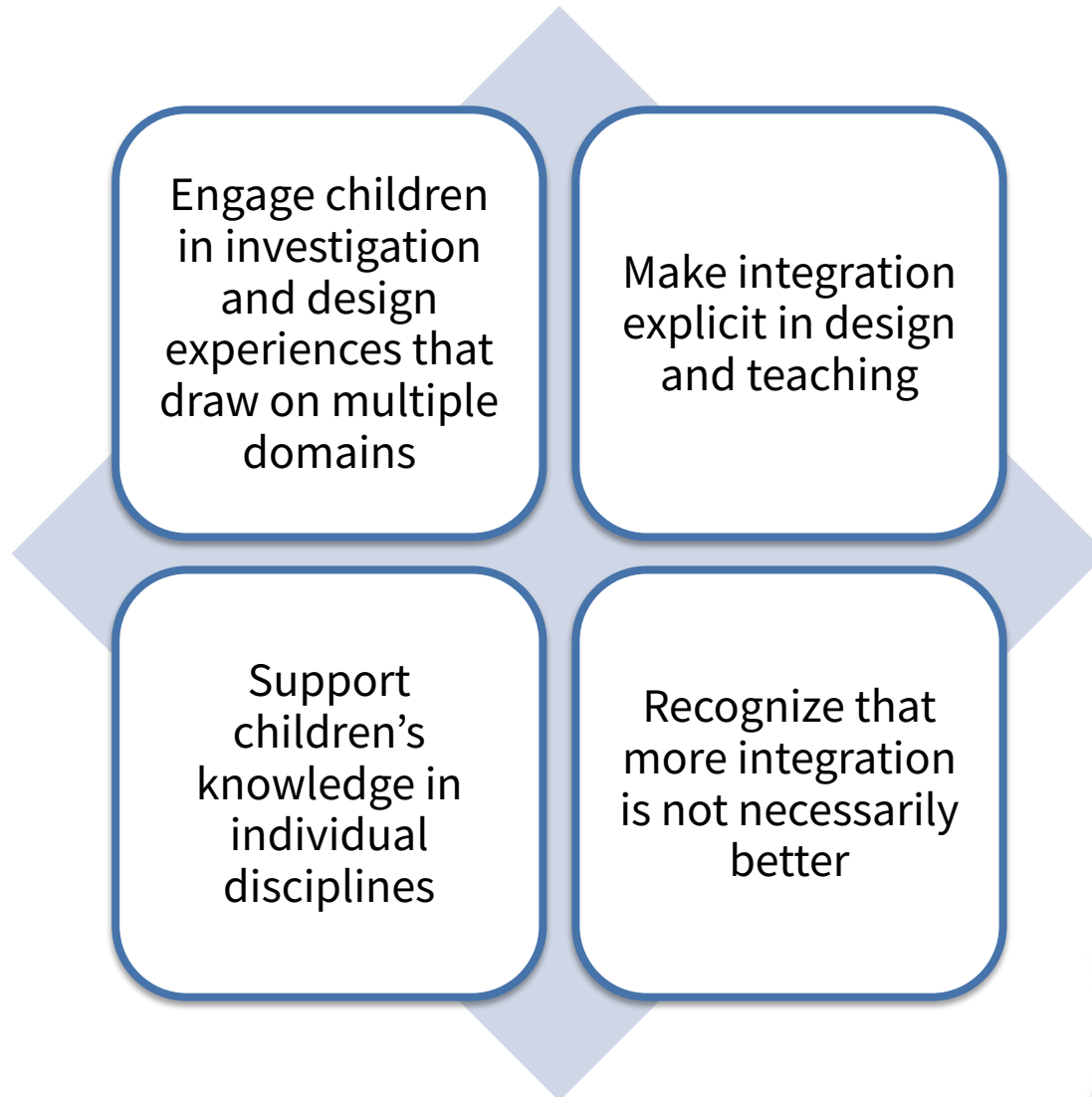
Collaboration allows for leaders and teachers to design meaningful and relevant learning experiences and helps families to better support their children's learning outside of school.



Curriculum Materials and Content Integration



Principles Guiding Effective Integration



Opportunities for Effective Integration

ELA

- Incorporate text to help children develop and deepen explanations.
- Incorporate text describing doing and using science/engineering and help children develop identities and interests.
- Support children in producing texts to represent reasoning.

Mathematics

- Help children engage in quantification.
- Support children in transforming and analyzing data, and understanding data representation and statistics.

Computational Thinking

- Use science/engineering contexts to highlight computational thinking practices
- Use computational thinking as method for exploring science/engineering concepts



Curriculum Developers should

Recommendation 10

Build **partnerships** with researchers, teachers, school or district leaders, and families and community leaders

Provide opportunities for children's sensemaking around investigation/design;

Build on children's interests & repertoires of practice;

Provide educative supports for teachers;

Provide opportunities for teachers to make productive adaptations;

Provide supports for teachers to make meaningful connections to communities and families;

Explore integrating with other domains;

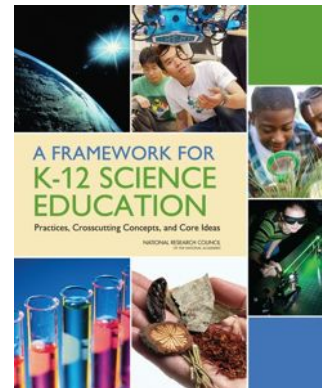
Manageable for use in preschool & elementary settings;

Align preschool and elementary instruction; and

Show evidence of effectiveness.

State and District Leaders should

- Rely on a robust **evidence-based review, selection, and implementation process** when making decisions about curricular programs to adopt
- Ensure science & engineering units build toward the vision of the *Framework* and are grounded in investigation and design, coherent, flexible, adaptable, and equitable.



State and District Leaders should

Sustained Professional Learning Opportunities

Adequate Access to Materials, Equipment, and Physical/Digital Resources

Ensure Every School Has Materials and Resources That Work Toward Equity and Justice



Supporting Educators



Teacher Educators, PD Facilitators, School/District Leaders should

Help teachers to recognize **importance and value** of teaching science and engineering

Understand and address **needs and goals** of classroom teachers

Support teachers in **connecting** their professional learning with classroom practice

Foreground **authentic and equitable** science and engineering content and disciplinary practice

Allow for meaningful **integration** of science and/or engineering with other subjects

Support teachers' effective **use and adaptation** of science and engineering curriculum materials

Support teachers in recognizing and valuing their learners' **conceptual, linguistic, and cultural resources**



District and School Leadership



District Leaders should

Provide professional learning opportunities for school leaders to enhance the leaders' capacity for providing instructional leadership.

These experiences should

- focus on science and engineering practices and
- support leaders in seeing multiple ways that science/engineering are valuable for children.



Closing Remarks

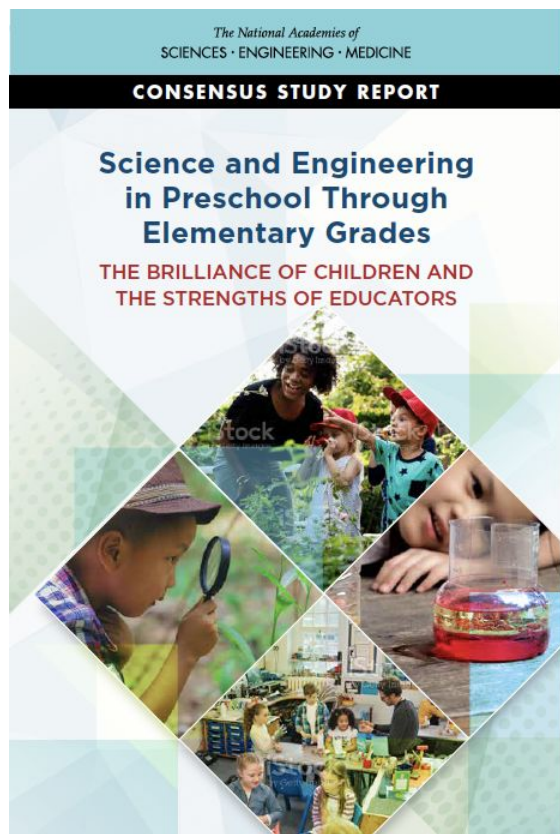


Areas for Further Research (a sampling!)

- Science and engineering pedagogies, curriculum, and teacher education and professional learning for preschool through elementary school that **emphasize equity and justice**
- **Children with learning disabilities and/or learning differences** and how they learn science and engineering
- **Integration** of subject areas, particularly outside ELA and math
- Incorporation of **engineering** in preschool through elementary settings
- Synergies among the **relational work and the disciplinary work** in science and engineering
- Teachers' and preservice teachers' **enacted practice** — particularly with regard to using pedagogies that work toward **equity and justice**



Questions and Discussion



You can obtain a PDF (for free!) or order the book at nap.edu — search for Brilliance and Strengths

Practitioner companion volume coming soon!

Check out the new “Interactive Overview” linked from the NAP page!



SEPTEMBER 2022

Learning in Practice

02



Learning in Practice: Introductions

Jenn Brown-Whale
(moderator)

Howard County Public School System
Resource Teacher, Elementary Science
Twitter: @ElemSci_JennBW

Learning in Practice: Introductions



- 42 Elementary Schools
 - 31 sites offer a PreK program
- Approximately
 - 1,300 PreK students
 - 24,000 K-5 students

Learning in Practice: Introductions



- Elementary Science Office
 - Amy Reese, Coordinator
 - Jenn Brown-Whale, Resource Teacher

Learning in Practice: Introductions



- Elementary Science Teacher Leader (ESTL) Cohort
 - Teacher professional learning and leadership initiative facilitated by HCPSS Elementary Science Office
 - Build relationships so that we may increase educator capacity in service of high quality science and engineering education for all students

Learning in Practice: Introductions

- Elementary Science Teacher Leader (ESTL) Cohort
 - Started 2016-2017 school year, 15 invited members, representing 11 schools
 - 2022-2023 school year we welcome 35 returning and new members representing 31 different schools



Learning in Practice: Introductions

Jenn Brown-Whale
(moderator)

Howard County Public School System
Resource Teacher, Elementary Science

Jennifer Atkins

Kindergarten Teacher,
Waverly Elementary School

Connie Haymon

Math Specialist,
Laurel Woods Elementary School

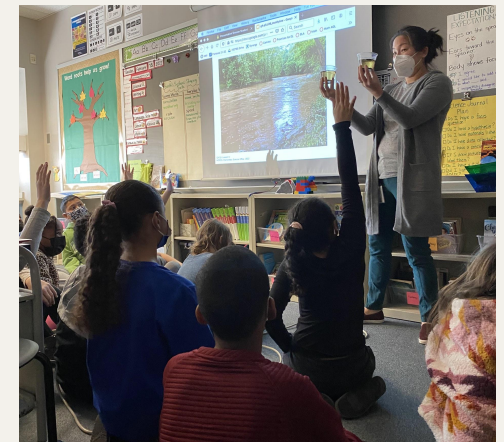
Linda Wilson

Grade 5 Teacher,
Manor Woods Elementary School

“Learning science depends not only on the accumulation of facts and concepts but also on the development of an identity as a competent learner of science with motivation and interest to learn more.”

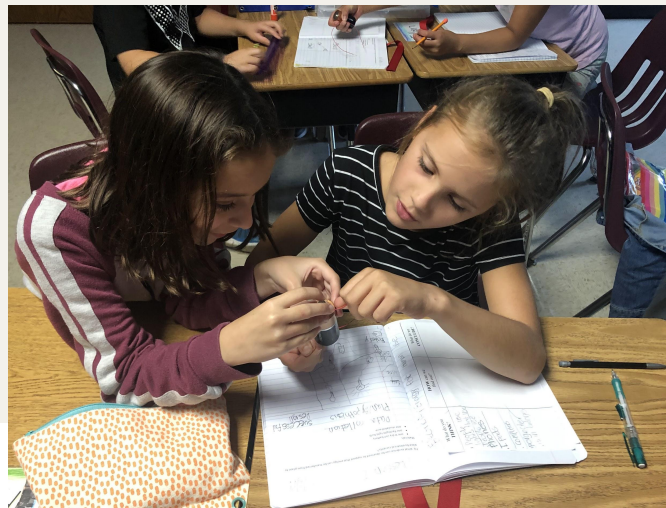
—A Framework for K-12 Science Education, page 287

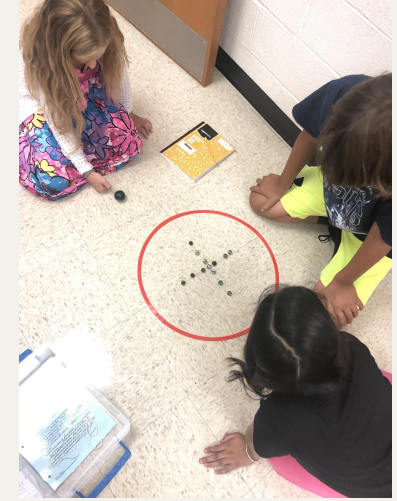
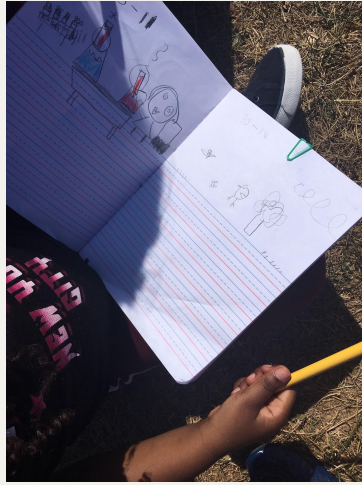
What’s your “why;” what brings you here as an advocate?



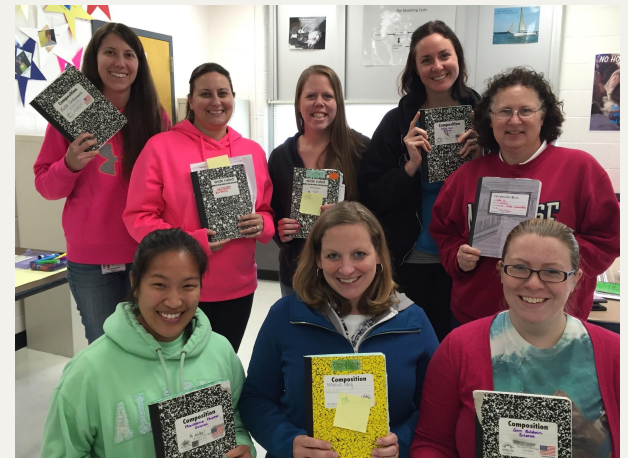


One recommendation that the report presents to educators is to position students as active thinkers and doers. How does this show up in your classrooms, or the classrooms you support?





What aspects of curricular materials help educators to put the committee's vision into practice?



How can leaders - *curriculum developers, content specialists, district leaders, school administrators, policy makers* - and teachers work together in service of high quality science and engineering learning for all students?



We are currently on
break.

We will return at 8 PT
/ 11 ET



03

SEPTEMBER 2022

Designing Curricular Materials for Elementary Science and Engineering



04

Panelists

Terrance Burgess

Michigan State University

Christine Cunningham

Pennsylvania State University

María González-Howard

University of Texas at Austin

Amelia Wenk Gotwals

Michigan State University

Ted Willard

Discovery Education

We are currently on
break.

We will return at
10:30 PT / 1:30 ET



05

SEPTEMBER 2022

Policy, Practice, and Leadership

06



Panelists

Kate McNeill
(virtual)

Boston College

Sara Mead

Assistant Superintendent for Early Learning, DC
Office of the State Superintendent of Education

Jennifer Williams

NSTA Division Director for Preschool and
Elementary Science Teaching, Isidore Newman
School

SEPTEMBER 2022

Sponsor Reflections



07

Sponsors

Amber Oliver
(virtual)

Robin Hood Learning + Technology Fund

Jim Short
(virtual)

Carnegie Corporation of New York

Adjourn

The practitioner volume is still in the works. Stay tuned for an update for when it is available.



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