TAKING STOCK OF SCIENCE STANDARDS IMPLEMENTATION: A SUMMIT
Curated Chat and Resources

OCTOBER 14 and 15, 2021

Below you will find the chat discussion for both days of the event. To the extent possible, some of the discussion has been grouped into themes to 'see' some of the discussion that individuals were having. Additionally, although many of the resources have been pulled out and can be find at the end of this document, some are hyperlinked in context. A special thank you is extended to **Rachel Connolly** for beginning the curation of resources on the fly.

Chat Discussion

Plenary Session

Richard Lahti, Minnesota State Moorhead: Does anyone know if the AAAS assessment site is gone forever?
Heidi Schweingruber: I don't know about the AAAS site, but I can find out!
Jennifer Hutchison: I am also very interested about the status of the AAAS assessment site

Heidi Schweingruber: We will be preparing a report based on the summit. It will include discussions on these 2 days, Dec. 8th and the in-person meeting in the spring. We also have plans to generate some interim papers.

Ted Willard: Wild to think that the Framework was released a full decade ago. I remember attending the meeting at NAS the day it was released (July, 2011, if I recall correctly)
Heidi Schweingruber: @Ted -- Yep! Exactly. I remember it well.

Heidi Schweingruber: A silver lining of shifting to virtual is how many people from so many different places can be an integral part of the conversation!

Cary Sneider: Good morning, and thank you for adjusting the timeframe for those of us on the west coast. I recently re-read the Framework and believe it is a fundamental breakthrough in US education. What a perfect time for this discussion.

Ellen Ebert: Proud to have been one of the 26 states. Tremendous work accomplished across the partners. Truly a community effort especially back in the home states. Thank you, Heidi!

Ted Willard: CSSS has been a key in the implementation of NGSS

Maya Garcia: Fun Fact: The K-12 Framework for Science Education is one of the most downloaded documents at the Academies
Jim Short: @Maya The Framework was the most downloaded publication from NAP for the decade between 2010-2020.
Ted Willard: For me, the chapter on the Practices is the 2nd most influential piece in science education literature.
Ted Willard: @Rachel, Science for All Americans (surprising no one who knows me)

Missy Holzer: @Maya - with there be a report of key recommendations generated from the summit? Apologies if Heidi answered this already, but I didn't see/hear her response.
Maya Garcia: @Missy yes, a report will be generated. All recordings and associated papers and resources will be posted as well :)

Nancy Kreth NISD: I love that Heidi - what a great way to speak about anecdote, evidence, and sway...

Michael Wysession: Substantial climate science is now in high school curricula for most of the country

Liz Wolf: Our large Ohio district has decided to adopt a high quality curriculum that follows the NGSS. We are late to the game but very excited!

Susan Wray: Agree Nancy! Happy to see Betsy representing elementary and am excited to hear more.
Elizabeth (Liz) Petersen: Preschoolers are the BEST scientists!!

Gary Myers: Here here! Brett does an amazing job helping adults really "get" 3D teaching and learning
Stacey van der Veen: @Gary, couldn't agree more, his work has really shifted ours in a positive way
Wil van der Veen: If you did not have the opportunity to attend Brett's PD, you should! Brett's vision has had a enormous influence on the PD I provide to K-12 teachers.
Tricia Shelton: You can view some snapshots of Brett's PD via video
Wil van der Veen: You can read about Brett's vision about what NGSS can look like in classrooms in our book

Richard Duschl: Couldn't agree more about the centrality of Formative Assessments in changing classroom culture and conversations toward cognitive, social, and epistemic learning goals - 3 Part Harmony!

Maya Garcia: @Michael the collaborations like Lead States, BCSSE, OpenSciEd, ACESSE, NGSX, and SPA-LC allow us to build those strong relationships. Convening and coming together have been essential to that work

Mary Starr (she/her) MMSLN, MI: Not much has been said yet about Taking Science to School. I want to share that for me THAT was the document that helped me start shift my thinking.
Maya Garcia: @Mary, I agree! I was fundamental to our implementation efforts in DC

Neil Lundgren: As an elementary science specialist, I'm glad that Betsy and others are working to train more science elementary teachers and show how much science young students can do!
Mary Starr (she/her) MMSLN, MI: @Neil Agree - Brilliance and Strengths is likely to shift elementary thinking. It really demands a deep read because there are vision changing perspectives share in it. Several AHA moments for me.

Amy Trauth: The decentralize efforts at improvement has been a REAL challenge – it's definitely hindered wide scale quality implementation in the past (NSES).
Ted Willard: @Amy The loosely connected systems that make up the US education system does make it hard to implement change. Inertia is not just a physics concept. ;-)
Stapleton, Mary K.: @Amy T. Agree decentralized efforts can be a hindrance. But I also worry when there is too much 'centralization' we run the risk of being pushed toward a 'one size fits all' model, which often caters to groups/people that are already in power/have more privilege. I don't have an answer here as it is a complex issue without an easy solution.

Amy Trauth: Hence why science education researchers would get radically different responses from science teachers when asking them about their notions of “inquiry”
Tom Keller: TSS, Learning Science in Informal Environments and State Systems for State Science Assessment were critical to Framework development

Kevin Anderson: Sticky - assessment systems and elementary science
Michael Wysession: CCCs still get the short stick
Kevin Anderson: Also very sticky - rigorous, relevant science for ALL students

Cindy Passmore: and I am indebted to the teachers with whom I have the honor to work who helped crystallize that distinction

Tom Keller: Traditional views and methods of assessment are holding us back
Maya Garcia: And yet @Tom, we hope that science is shifting the narrative on assessment in ways that are not accessible to our colleagues in ELA and Math

Dr. Michal Grant Robinson: Science is only taught in elementary school if it is tested!
Kevin Anderson: @Dr Robinson - in Wisconsin we test science in elementary and have some other nudging policies, but that doesn't seem to move the needle. It's really all about the priorities of local leadership.

Elizabeth (Liz) Petersen: math makes more sense when it’s embedded in the science practices.
Jackie Engel: There's a lot to be gained by including science in language arts too, especially in regards to academic language.
Patty Brown: @Elizabeth I have lots of light bulb moments as a teacher illustrating your point that math makes more sense when embedded in something tangible as in science.

Kim Cheek: The lack of prioritization of science and engineering has been a perennial problem in elementary school. We have been working on this for a long time. There are great projects out there, but we continue to struggle to get to scale.

Lacey Wieser: Traditional course structures, especially at HS, makes it difficult to implement ALL standards for ALL students
Maya Garcia: +1 Lacey, grappling with HS pathways is certainly something we want to discuss as a community

Nancy Kreth NISD: Sticky - the notion that students can only learn once they know how to read...still prevalent in elementary classrooms...exacerbated by "learning loss" from COVID

Dr. Michal Grant Robinson: English Language Arts, Math, Social Sciences, Fine Arts can all be incorporated into science

Joseph Bellina: on the on hand cheap standardized tests are a problem on the other hand without that in science it will never get time in the classroom tough choice

Deb L. Morrison: ++ Betsy on supporting teachers in engaging children in effective and equitable talk and listening closely to the resources leveraged in this space - http://stemteachingtools.org/pd/playlist-talk

Allison Greenberg: This elementary science equity issue has been my constant mission since starting teaching.

Ted Willard: Sticky Point: I think the vast majority of teachers do not yet understand the shifts expected in by NGSS and other standards based on the Framework. This is through no fault of their own, but is a result of systemic issues, particularly a lack of time and professional learning. Many of us at this meeting may think of these changes having been going on forever, but for many classroom teachers, they are just getting their first sense of the need for change, and some aren't even aware that change is necessary.
Stacey van der Veen: @Ted yes! And I don't think we always acknowledge what a significant shift it is
Jenny Gammill: @Ted. Yes, this is so true in Arkansas (what I'm seeing as I work with teachers)
Danny Edelson (he) BSCS: +1 Ted: We are still only on the first step on that path.
Bev DeVore-Wedding (she/her): @Ted agree 100%; when standardized testing is at 5th grade, PK-4th grade teachers do not think about science and with NGSS and new state standards, elementary science is still being an afterthought. Generally of course, not everywhere.
Jake Foster: As a Board member of a science PD organization here in MA, I am constantly frustrated that science professional learning is functionally a philanthropic endeavor rather than a core function or responsibility of schools.
Heather Johnston: +1 Ted, professional learning for current classroom teachers that's relevant for the level of students they teach is needed…along with time and admin that see and support this.

John Galisky: Maybe it's time for science-literacy integration researchers to stop publishing in science ed journals and start publishing in literacy ed journals.
Deb L. Morrison: ++ John, I think publishing in places like Teaching and Teacher Education help us engage in "teaching" conversations more broadly in ways that help us all learn across disciplinary boundaries as well.

Jessica Ashley: Some major sticking points in my region in Michigan: Time for elem science; HS ESS resources; HS Physics resources; HS Chem Resources ; and most currently --- a reform needed for job-embedded PL to support teachers with implementation. Knowledge doesn't equal transformation. They have a lot of knowledge, but the "in-practice" PL is what is needed.

Rachel Connolly: The opportunity space between Multigenerational Learning and STEM Ecosystems is huge

Patty Brown: Too much "stand and deliver" in high school, content-focused, neglect of practices and application in the real world
Amy Trauth: Yep, I agree with Michael. It too TOO LONG for HQIMs for high school to become available.
Maya Garcia: Or even funds connect to ESSR or the Cares Act dollars
Christy Glore: As someone in assessment, I am all ears!
Nancy Kreth NISD: Agreed Mike - finding a way to replicate the amazing work by amazing teachers remains the challenge.

Kristin Rademaker: So true, these are not new problem.
Amy Trauth: We can press for small shifts among inservice teachers over time IF we have HQIMs to coach and provide PL around.

Joseph Bellina: i have found that school principals can make or break the pd i have done very frustrating
Kristin Rademaker: @Joseph having admin support in any change is so important.

Patty Brown: In 1974 in community college I had an awesome instructor in natural history who gave 1:1 oral assessments.

Kevin Anderson: +1 on high school materials - just talked to a frustrated HS principal about that this morning

Amy Trauth: We should NOT be asking science teachers to make sense of the standards (and shifts needed) AND ALSO write curriculum and assessments

Jackie Engel: I'm in a virtual charter and it is impossible to find NGSS aligned lab kits/ materials that are easily implemented and yet reasonably priced for our students as well.

Amy Heidner: My take is that -administration-, buildings, school boards and school districts, these are the bigger problem. Teachers need support, and PAID time to learn, adapt curricula and worksheets, etc. If NGSS is as important as standardized testing, then we need to get as much support. It's not teachers are unwilling, it's lack of support.

Amy Trauth: It's fundamentally unfair to science teachers and unreasonable

Rae McEntyre: Re: teaching science in elementary schools. I heard a story recently from a science teacher who was a principal in an elementary school. He said "I'm going to make this a science school." He then shared that other priorities, coming from the district, prevented him from fulfilling his personal vision. This makes me wonder--how do we show those relevant, natural connections (like math/ELA), beyond published research, to those at the upper leadership levels in districts?
Nancy Kreth NISD: +1 Rae - this has happened in my district as well.

Matt Krehbiel: "Doing the standards" is less important than "Using the standards as a lever to improve science education"

Ted Willard: I would reframe what Mike is saying to be we need to not let the perfect be the enemy of the good. I also think this goes to the point of the difference between articulating the dream, and how to make the reality move in the direction of the dream.

Beth Covitt (she/her): From Cohen and Mehta (2017) "System-wide reforms did succeed when they solved problems that educators had or could easily learn that they had, were broadly consistent with the reigning purposes and organization of public education, and implementation did not require deep change in instruction and thus did not require extensive capacity." NGSS is a tall order with regard to education reform. School and educator perspectives are so important.

Richard Duschl: Michael is raising important Improvement Science and DBIR issues about understanding the systems with which education actions and decisions take place. It's a long haul!

Bill Penuel (he/him/his): For those of you wondering where free materials are, they are available! I am part of the OpenSciEd initiative that has developed a middle school program, and am part of the HS initiative: https://www.openscied.org/

Mark Meszaros: +Michael; NGSS is hard, it is difficult to develop curriculum material to really help teacher teach NGSS. It is also difficult for teachers to make the transition. We are making progress and the framework and the implementation goals are a great start.
Kevin Anderson: Agreed, Mike! What's best for kids must be the focus. We get stuck in our siloes and in the space of fidelity to some materials or idea of what things should look like. For example, STEM has

been a big area of this in Wisconsin - stuck on defining and delimiting it rather than just engaging students meaningfully.

Allison Greenberg: How can we create a systemic shift in curriculum and instruction from purchasing siloed curricula (ELA, math, science, social studies) and moving towards integrated PBL curricula with science and engineering anchoring the math, ELA and social studies learning?

Mark Meszaros: +Tiffany, AMEN, change does take time. We are making progress.

Patty Brown: Teachers need time to talk to each other about science instruction and access mentors, even virtually.

Jackie Engel: Mentorship and community is huge!

Maya Garcia: And also retention issues with existing teachers
Lori Andersen: Especially at this point in history, Maya.
Zoe Evans: +1 Maya - Teacher recruitment/retention is so important.

Ted Willard: I do want to also note that as someone who has been involved in standards based education for a long long time, the changes that have gone on since the Framework and NGSS were released have been greater that the changes that came about in the decade after the release of Benchmarks and NSES. As a community, we are getting better at this and making progress.
Wendy Binder, NSTA: @Ted I so agree- the changes are so apparent even if its slow

Arthur Camins: There is a fundamental problem. As a country, we don't agree about the purpose of education. Too few people see developing critically thinking citizens as central. So sense-making science is contested or at least, undervalued.

Christine Cunningham: I would *strongly* encourage folks in this chat to keep an eye on and provide feedback about the NAEP Science Frameworks. I'm on the National Assessment Governing Board and we are revisiting these Frameworks now. We very much need the voices of folks in this gathering to help ensure that the NAEP test reflects what we are hearing today.
Kevin Anderson: @Brian and Christine - is a change in the NAEP framework going to meaningfully move the needle? I have my doubts...
Dr. Michal Grant Robinson: @Christine Cunningham I served on the NAEP Science Standing Committee and remember Brian Reiser being on the committee also and strongly vocalizing how NAEP should be more aligned with NGSS (with each question discussed).
Ted Willard: @Kevin: Lots of small steps. Being able to tell state leaders that changes are needed in science instruction to keep NAEP scores up has an impact on what gets attention
Christine Cunningham: @ Kevin. A number of states and superintendents do attend to NAEP results. If we are going to have a national measurement, it would be much more useful if it were aligned with what we are advocating. If not, it sends a different message about what is importnat.

Amanda Collamore: I think another important point is to ensure collaboration among teaching teams. Working with students to see how the subject works in the real-world, removing (or at least blur) the siloes in the education subjects. Why should students only read classic literature in English? Why not also read a scientific journal?

Elizabeth (Liz) Petersen: Let's add that 4th dimension to NGSS!!

Susan Wray: The influence of one person is contagious. I was that traditional teacher and then I met Tiffany and now I am leading teachers across our state. We can change the lives of teachers and students over time.

Rachel Connolly: The impact that the pandemic will have on remote/online learning
Breigh Rhodes: 2020-2021 alone has felt like a decade, Heidi! :)
Jody Bintz: Adding to @Rachel...and on our teachers and school leaders.

Michael Wysession: The increasing politicization of science over the past decade

Ann Crotty: Echo Phillip Bell --- Relationships, relationships, relationships! partnerships, partnerships, partnerships!

Deborah Farias: The systems and structures of our education system are antiquated and perpetuate inequities that were designed into the system in order to "sort" kids. Instead of trying to fit the shifts needed in teaching and learning to meet the needs of our learners in this antiquated system, we need to think about how we can change the systems and structures.

Patty Brown: I still feel like assessments are too often used to admonish teachers rather than support them.

Sheldon Margulies: Why is biology generally taught before chemistry when so much of biology is chemistry of the cell?
Patty Brown: A strong integrated middle school science program could help students make connections more easily, such as the one @Sheldon mentions.

Philip Bell - UW Seattle, he/him: If people have not explored the awesome work of the Learning in Places project, I really encourage you do check out the dozens of frameworks, storylines, and learner engagements. It is led by Prof. Megan Bang and Carrie Tzou.

Gregory Borman: It will be increasingly important to align science education to culturally responsive sustaining education- taking account of the cultural and linguistic assets that children bring to the classroom need to be leveraged and respected- this is where we are beginning to make some progress in science education.

Rae McEntyre: +1 Tiffany. KY is currently going through a review/revision process for our standards and my committee members are saying the same thing. It would be a disservice to teachers to make huge changes (of which my members currently are not doing).
Rachel Aazzerah: Absolutely, Tiffany! We cannot continue to work in silos.

Ted Willard: Personally, I think the system is still trying to incorporate what the current standards are. I think any major changes right now in the Framework or Standards would be destabilizing.
Aida Awad: +1 Ted, and perhaps especially for the ESS

Amy Himes: I appreciate the idea of slowing down! Thank you, Tiffany!

Maya Garcia: Kudos to collaborations that support implementation efforts. What are some collaborations that support your work?
Deb L. Morrison: @Maya….www.climetime.org

Tiffany Neill: Link to the Attributes for Science Standards we used in Oklahoma

Patty Brown: Two summers ago I spoke with an elected Representative in Idaho who was leading the campaign in her state to reject the NGSS standards which had been adopted in Idaho. She considered them “anti-mining.”

Richard Duschl: States’ monitoring of science learning via Standards should not trump Districts’ focus on their students’ learning. Yes to Michael - it’s local
Ted Willard: @Michael: Are you saying it's all LOCAL? Please don't mince words. If you think that, you should say it explicitly. ;-)
Amanda Collamore: It's all local. What a great mantra!
Liz Wolf: Agreed @Michael! I get in 50 science classrooms per month as a Science Curriculum Manager here in Cincinnati. This is where the magic happens and those relationships that are crucial are created!

Maya Garcia: Time to transition and grapple with these shifts is so critical

Rachel Aazzerah: Absolutely, and being someone that is in the trenches as a curriculum/assessment director, there is local pushback in regard to a focus only on math/ELA at elementary due to "learning-loss" caused by the pandemic.

Philip Bell - UW Seattle, he/him: Thanks to NSTA for making that equity chapter linked above freely available from the Practices volume!!

Julia Crane: Us locals need help! My state is so focused on literacy and math that science is hardly taught in elementary. We need someone to intervene for us at the national level.
Lori Andersen: Yes, Julia. Elementary needs more support.

Deb L. Morrison: While I agree the work needs to be locally contextualized and place and community connected, real supports for educators and districts need to also provide resources and professional learning opportunities that might be regional, state, or national in nature.

Matt Krehbiel: @Michael—AND if you want to make local work, you have to think beyond local. Just like teachers can’t think about only their own classroom, districts leaders can’t think about only their own district.

David Jacob: It is very difficult at the local level as I work in a region in New York. Awareness and understanding of local educational leaders is weak to none.

Bill Penuel (he/him/his): The work is local, but the political strategies require solidarity and coordination across different places. Also, the vision of the Framework is shared across places. And the political winds — while all highly local — are nationalized in terms of their discourses, including those that are working actively to make it difficult for leaders to advocate for equity in science education.

Joseph Bellina: what happens when the is a local problem eg evolution and climate change

Maya Garcia: #dobetter
LeeAnn Mikkelson (she/her): Do better for, right now
Ted Willard: Project 2061 Anyone?

Patty Brown: The phrase “argue from evidence” found in so many of the performance expectations of NGSS is so critical. So many who get all their information from FB don’t even know how to assign weight to evidence. If students can learn how to judge validity as well as carry out meaningful investigations, it would be so helpful.

Marceline Collins-Figueroa: Thank you for a comprehensive beginning to this meeting. I am a retired science teacher educator from the University of the West Indies, Mona campus, Jamaica. I have utilised and learned from NASEM science education reports for many years to the benefit of my students and others in the partnerships I work with.

Nikki Snyder: +1 Tiffany it is important to leave space for new voices to be a part of the conversation

Christa Haverly, she.her.hers: Some structural barriers are located outside of the field of science education - we also need to find ways of engaging in these conversations outside of our field in order to see change in our own.
David Jacob: Local educational leaders without a science background are not always in touch with the national vision.

The Landscape of Implementation Session
Christa Haverly, she.her.hers: …Time for instruction in elementary
Ted Willard: I think the one thing I would add to this that I find the hardest thing to overcome is when an educator says "We already do that."
Joseph Bellina: yes especially when they don't see the difference at all
David Jacob: @ Ted Willard how about "We don't want to do that"
Gary Myers: Right Ted? Or, "It's just good science teaching" without being intentional about the process
Ted Willard: @David I think that "we don't want to" is easier to deal with than "we already do it". If they don't want to, it means we need to get them to see the benefits.
David Jacob: @ Ted unless you get a group of those teachers in a room and they form a block. Both are difficult in very different ways.
Mary Starr (she/her) MMSLN, MI: @David - social media can help us do some of that work. It gets people into the "same room"

Jaracus Copes: I agree Stephanie adults put their insecurities around STEM on kids

Dua Chaker: Nice to hear from you @Jennifer! TeachEngineering.org recently submitted a resource to the PRP and are excited to have the possibility of having our resources featured by NextGenScience!
Jennifer Self: Thanks Dua! We're thrilled to be able to find and share out high quality examples with the field.

Jim Short: Love Cynthia Coburn's piece on rethinking scale like Jim Spillane is talking about

Betsy Davis - she/her: Spread, spirit, stake, and stick -- so helpful!
Mary Starr (she/her) MMSLN, MI: @Betsy - I love that! We can leverage that for a systems approach people can better understand. S, S, S, S

Philip Bell - UW Seattle, he/him: "By not doing science we are harming people… lives are literally on the line" — Stephanie Marshall
Lindsey Roy: + Stefanie! Lives ARE on the line!
Darcy McMahon: + Stephanie, Great framing: "By not doing science we are doing harm to students."
James Emmerling: Lives are on the line without science education. LOVE IT! @Stefanie
Nicodemus Ford: Thanks, Dr. Marshall for sharing that story and for framing this work
Kevin Anderson: Love that story, Stefanie - need to support these "realities for all students" !

Jamie Rumage (she/her): @Stefanie - Yes, thank you for naming this. How do we create this reality for every student? Lives are on the line!

April McCrae: I feel like the science education community is strong, but within the EDUCATION community science is sometimes minimized.
Texas Gail Raymond: @April - I would say often

David Jacob: @ Stephanie Yes! Science ed is not an EXTRA. It is a cornerstone to the future.
Christa Haverly, she.her.hers: +1 Stefanie! A chid's zip code or race should not impact their access to quality science instruction.
Nikki Snyder: @Stephanie this is powerful! How many other Faiths are out there!
Deborah Farias: We are living the repercussions of marginalizing the teaching of Science and SS in our elementary schools
Lisa Owens: @Stefanie, leveling the playing field for ALL students is my Why. ALL students should have access and believe they CAN.

Maya Garcia: Priya Parker says.. what is worthy of our collective time.

Ted Willard: We need to push against the idea that science is a "treat" and focus on it as one of the essential food groups. Children who do not have science in their lives are malnourished.
Kristin Rademaker: agree Ted, especially at elementary where too often science is looked at as a 'special'
David Jacob: @ Ted. Agreed. I recently said to about 600 elementary teachers over multiple sessions. "Science should not be treated as indoor recess" it is a subject in its own right and is not just hands-on but minds-on as well.

Angela Marie Lyle: +Bill the pivot role of districts and schools in enabling this work
Tiffany Neill: @Bill keep coming back to the vision, and work on components of the system!!!
Amy Heidner: -Bill P In WA the buildings have no control over graduation requirements (that is state-level), nor often, do they control the curricula (often district level), and while they typically do individual schedules for teachers, the bell schedule may be district level.
Bill Penuel (he/him): @Amy: One challenge in our systems is decisions are made at different levels in different places. The key is knowing where they are made, how they are made, and finding ways to influence thosedecisions

Liz Wolf: Yes! The science of reading says that background knowledge is essential to learning to read proficiently. Yet the subjects that build that background knowledge is so often not taught with consistency. Background knowledge is also built through field experiences but funding is hard to find at times!!

David Jacob: Assessment helps move the agenda "make space" but should not be the goal.

Arthur Camins: Isn't the central vision really about the value we place on equity, evidence, and caring about other human beings? These are all contested at this moment.

Bev DeVore-Wedding (she/her): Science also complements mathematics, reading, writing, social studies, art, music, sports, oh just everything in life.

David Jacob: @ Jim Yes. Science is the application of ELA, Math, Social Studies, Art....

Mary Starr (she/her) MMSLN, MI: We have trying to flip that language @Bev to say math, ela, etc complement science. Starting with science.
Joseph Bellina: done well students are interested in science if we don't kill their curiosity
Wil van der Veen: I wonder how our own previous experiences with learning science in school affects the way we view science as a priority compared to other subjects taught.

Nathan Spencer: yes @Jim, we need to lift the democratic importance of science education

David Jacob: @ Jenny. It is great to have partnerships, but not all districts have these partnerships. How do we support ALL districts, teachers and students?

Joseph Bellina: teacher's prior experience clearly impacts how they think about science teaching and learning

Philip Bell - UW Seattle, he/him: Given Jim's important highlighting of the connection to the climate crisis, people might be interested in this new set of articles on climate justice in science ed in NSTA's Connected Science Learning. Another batch of articles are coming within the next week.

Deborah Farias: As our systems and structures in the education system and our schools are antiquated and built around the inequities that were designed to sort kids, professional learning on these important shifts to teaching and learning are immensely challenging to sustain in the context of the classroom fo our teachers.

Rachel Aazzerah: + 1 Jim As a district level certified administrator, it is fascinating that during an administrators preparation program there isn't a focus on Science. It is if the administrator to be has a science or STEM background, they are able to leverage science to be taught.
David Jacob: @Jim +1 Very important statement. Very true
Zoe Evans, Bowdon High School: @Jim literally just used the line I have written in my notes for later!
Richard Bacolor: Yes Jim….admins are also gatekeepers in terms of HQ materials…and many are happy with materials that mysteriously get used a lot but do not align to the vision.

Bill Penuel (he/him): We also need to be considering community-based leaders, families as enacting leadership (related to Family Leadership Design Collaborative Phil was sharing links for earlier)

Tiffany Neill: Science directors in districts across the nation have played a pivotal role in implementing this vision. They are a powerful force!

Zoe Evans, Bowdon High School: The principal is just one of the leaders in the building that can bring about meaningful change. Thank you for recognizing the importance of teacher leaders. The school principal only has so much power… when the classroom door closes… power completely shifts to the teacher.

Philip Bell - UW Seattle, he/him: If school leadership is against the systematic teaching of science (or social studies, art…), do we have an obligation to infrastructure and support teachers who are willing to still teach science take up what I have heard referred to as "secret science?"
Rachel Aazzerah: @Phil Secret Science is very real. Educators can be afraid of their evaluation if they decide to teach science.
Brian Reiser: @Phil I think the idea you are bringing up is really important and we see this in some of our partnerships. It would be helpful to talk about some strategies that support teachers in that kind of situation.

Philip Bell - UW Seattle, he/him: @Rachel: Agreed! I see it a lot as well. The science ed community needs to have their back when they hold that line on behalf of scientific literacy.

Jessica Ashley: Ideal situation: All teachers view themselves as leaders --- and own Brene Brown's definition of a leader: "A leader is anyone who takes responsibility for finding the potential in people and processes, and who has the courage to develop that potential."

David Jacob: @ Stefanie True statement. Building leaders are often left out of the conversations.
Christa Haverly, she.her.hers: Adding onto @Stefanie, when I ask principals what they're looking for in elementary science, they reference Marzano….
Ted Willard: @Christa "they reference Marzano" is the most depressing phrase I have seen or heard today.
Angela Marie Lyle: +Christa…yes, there is also evidence of limited training on what the NGSS entails, as Stefanie mentioned

Leslie Silbernagel: Working now on a set of modules for school admins and instructional coaches with no science background.
David Jacob: @ Leslie would you share your work?
Leslie Silbernagel: Most of my principals and district admins were gym teachers.
Leslie Silbernagel: I'm doing the work for CINSAM, the STEM center for Northern Kentucky University. It should be posted in January.
Bev DeVore-Wedding (she/her): @Leslie When my principals were science or math educators-wow what we could do. My first non-science/math principal had no clue. Asked me what doing investigations in math would do for their standardized test scores...why wasn't I using more worksheets? SMH

Kevin Anderson: Great point, Stefanie! I hope to see all subjects move toward a phenomenon-based approach, making learning better and PL more straightforward.
Zoe Evans, Bowdon High School: +Stefanie - What we get is related to HR.
Amy Himes: That is such an clear and honest observation, Stefanie!
James Blake: +1 Kevin - looking forward to going back through some of these comments from the angle of a principal/supt/ state science supervisor…

Jessica Ashley: NGSx has a principals/admin pathway to realizing the vision of science ed.
Melissa Niemi: And if administrators had a bad experience as a science student, they especially aren't interested
David Jacob: @ Melissa Yes adult experiences with Science can be a barrier

Daniel Alcazar-Roman: Distributive leadership is critical for sustained improvement in science particularly in school systems where there are high rates turnover of for superintendents and principals

Deborah Farias: The brave, daring, transformational leaders our student and adult learners deserve also need to bring the family community into the call to action and the shift from vision to implementation.

Amy Himes: Admin need to observe the art teacher one day and the science teacher another day, so they naturally default to something like Marzano.
Stacey van der Veen: I couldn't agree more about teacher leaders - unfortunately they often end up carrying the NGSS torch alone, we've often abdicated responsibility for implementation to them

Tiffany Neill: @Stephanie such great points. What is your take on school leaders being open to "STEM" providing funding and space and time for this, but not science?

Amber Carter: TIffany, but Science is STEM. The same standards and same implementation. It should all be imbedded together. So if they are willing to fund STEM then people should look at that as funding Science and spend that money accordingly. It all goes together.
James Emmerling: In the elementary report it shows this is bad for science and doesn't hardly improve ELA and math. "2 Preschool and Elementary Systems and Structures."
Tiffany Neill: @Amber I totally agree, but they fund and make time for programming that is absent of the four disciplines that represent STEM. I guess what I'm wondering is if they don't have a strong background in STEM but they continue to find space and time for it, how do we leverage this enthusiasm for science.
Heidi Schweingruber: @Tiffany -- how to we remind people that science is the S in STEM.
Amber Carter: @Tiffany, I totally get what you are saying. If the admin isn't showing the same type of enthusiasm then show them the framework and how they must be taught in conjunction in order for the three dimensions to be successful.
Tiffany Neill: That's the key @Heidi, especially with school leaders. We need a focus on this I think.

Bill Penuel (he/him): Want to share a finding related to this discussion on conditions for supporting coherence and equity together: Equity Across State Systems: Possibilities and Tensions in Understanding Scale

Christa Haverly, she.her.hers: @Stefanie, and is that good for students? Also, no.

Joseph Bellina: how about administrators seeing computer science as another form of science!!!!

Deborah Batzer: Are there experts you suggest that will come and present to the leadership for counties that can present what is it that you all are talking about?

Ted Willard: I would love to see data on hours devoted to science instruction in elementary grades vs. PE, art, and music. (Not to demean those activities at all)

Rachel Aazzerah: Stefanie- NCLB -PTSD.... absolutely!

Caroline Kiehle: To address this need of supporting science instructional leaders…ISB (Seattle, WA) has a prof learning series avail for whole-district teams of principals, "P4P— Principles of Science for Principals" that we run in parallel with teacher PD.
Amy Murphy: @Caroline-I would love to chat more about this with you. We are developing a PLC for school leaders around science instruction.

Deb L. Morrison: ++ Stefanie and Jim….Understanding the multiple ways of knowing and doing science and the intersectionality with other disciplines in the context of the real world issues we face. How we best support Infrastructuring!

Liz Wolf: I'm in Cincinnati Public Schools. We are pushing as a district for increasing consistent science instruction at the prek-3 level science and are getting a lot of push back from Principals and our teachers. It's a slow and steady process to change people's opinions. It's going to happen through relationships and community involvement.
Leslie Silbernagel: @Liz I'm at the NKU STEM center, we are here to help you with that work if you would like to collaborate
Liz Wolf: @ Leslie - Yes! Let's get together specifically for these grade levels. You know how to find me. :)

David Jacob: @ Jim Help with a local assessment rubric for all three Ds for teachers to produce that data would be helpful

Arthur Camins: We need to raise the value and importance of informed citizen participation (for survival) and science education as an essential tool.

Kristoffer Carroll: We have been working diligently in the space of inviting and encouraging school admin. to participate in rich science professional learning with science teachers and without. They are in a difficult situation of balancing the current emergencies/fires and wanting to be instructional leaders. Building capacity with school leaders is essential and also takes focused effort to eliminate the "noise" and quick (unsustainable) solutions.

Amy Heidner: Regarding principals without science background - one necessary method is to get existing principals some sci-Ed knowledge. But looking forward, we also need to encourage science teachers to move into administration!!

Brian Reiser: When science education meets the learning sciences — nouns become verbs.
Todd Campbell: Here's a piece from our work influenced by Bill with infrastructuring as a verb (with mentor ts, district leaders, state leaders)
Here's another piece from Phil in JSTE (free access) Infrastructuring Teacher Learning about Equitable Science Instruction

Maya Garcia: We have to be intentional about increasing access and networking for our rural networks

Bev DeVore-Wedding (she/her): Or harm when science is not taught well

Bill Penuel (he/him): It is not specific to implementation, but the Horizon reports that have looked at math and science teaching are a good indication

Matt Krehbiel: Absolutely! Every implementation plan should include goals and specific actions for connecting with the local community and building partnerships within and beyond communities. We need a bigger team.

Liz Wolf: But on grade level work doesn't often align with state standards and NGSS based resources.

Ted Willard: Actually, I would say that Florida and North Carolina are the only holdouts of states that don't at least make some specific reference to the Framework in their standards
Bill Penuel (he/him): We also actually know that the most commonly used source of research among leaders in these efforts is the Framework. And folks are using common resources, as Jenny notes
David Jacob: @ Jenny In NY we have those differences. Not huge differences but important to point out there are differences to be mindful of
Christine Royce: Ted -- At the moment I would say Pennsylvania as well --- although there is a process to develop new standards at thtis point.
Ted Willard: @Christine... Yes, I am thinking about their current standards development process
Lin Andrews: FWIW: There are 6 non-framework states: NC, FL, VA, TX, OH, PA.

Linda Cook: Some of the elementary teachers in my district shared that they did not believe that many of their elementary colleagues had experienced inquiry-driven learning in their own experiences. Modeling this is critical if we want teachers to see the value of these learning experiences for students.

Nikki Snyder: @Linda I think this speaks to the need for high quality PD for ES teachers where teachers can play the role of student and have the personal experience of figuring out the science for themselves. Let them have have the aha moment for themselves!

Matt Krehbiel: If you need research support to make the case for the importance of building partnerships, see chapter 7 of the Guide to Implementing the NGSS

The Role of Leadership

Tina M Larson: Love the comment about trying to see that legislatures, etc…"do no harm"…..sad but true! =:)

Ravit Duncan: Absolutely! Continuity and great leadership matters so much!

Christa Haverly, she.her.hers: The 'all standards' part of Mike's phrase is important in the context now of identifying 'essential standards' - science education leaders are having to push back against this task….NGSS is designed as a set of essential standards already
Mary Starr (she/her) MMSLN, MI: @christa. Totally agree - we have had a large push for Power standards in response to "learning loss" It is hard to push back on that.
NVPS: +1 Christa - this is a question I get asked by principals often.
Amy Murphy: @Christa-I agree. In AL our standards are NGSS like, so when we had to select "critical" standards, we selected those most aligned to NGSS.

Neil Lundgren: @Elizabeth, I'm glad you mentioned Nature Centers. Some of the best "teacher training" I think I ever got was during a summer internship I had at a nature center.
Maya Garcia: Informal partners have played a huge role in implementation efforts

Maya Garcia: For me, our environmental education partners in DC were critical partners in our implementation efforts

Arthur Camins: What role can (should) official leaders from the school to the state level play in helping teachers navigate (withstand) the political winds and private funder influence that often constrain our efforts to act on the vision of the Framework and NGSS?

Maya Garcia: It would be great if more districts dug into the data around science course taking patterns

Aida Awad: Hmmm … I'm not seeing Earth Science?
Rebecca Cmelik: Nope, Earth Science isn't *required* for college, so it doesn't matter for a lot of schools.
Aida Awad: @Rebecca … that's not in alignment with NGSS though!
Christine Salloom: They may have the earth and space standards embedded in bio/chem/physics like the CA 3 course model
Rachel Connolly: The Earth Science course requirement is a real challenge with the need for climate change education
Aida Awad: When ESS are integrated into BCP, is a highly qualified geoscientist teaching them?

Maya Garcia: I often wonder about how math performance serves as a gatekeeper to HS science courses
Maya Garcia: We might do the same with elementary Master schedules

Heidi Schweingruber: @Maya -- we will be able to address that question through the new consensus study on Equity in K-12 STEM education! We are finalizing the committee now.
Mary Starr (she/her) MMSLN, MI: @Maya I wonder if/how reading level in elementary/middle school is a gatekeeper to middle/high school science courses.
Christa Haverly, she.her.hers: @Maya - we're gathering school schedules as part of our research on elem science…. Will be interesting to do some analysis on them
Linda Cook: @Maya - the Texarkana district in Texas helped solve the math as a gatekeeper problem by beginning with the kindergarten math curriculum and vertically aligning K-12 so that now students are able to take up to 2 years of calculus in high school be be better prepared for the engineering jobs and careers in the community.

Ted Willard: If I am reading the chart right, more 11th graders are taking no science now than were in 2011. That is unfortunate

Liz Wolf: Student choice surveys are so important when adopting a new curriculum. We just surveyed 1,000 9th graders and over 50% want to take astronomy. Empowering students in their own educational journey is essential!

Todd Campbell: How to support post-secondar access while also contesting a system and practices of exclusion that limit expansive forms of participation in sciene while also changing what we count as science

April McCrae: Do any other states or districts on this presentations work with Immersion (language) learning and science education at the elementary levels?
Liz Wolf: @ April - @Iam CPS is adopting a high quality curriculum for science and world languages for implementation in the 22-23 school year.
April McCrae: Immersion language learning through science education is a fantastic pathway for students at the elementary level in terms of equity--especially for EL students and Native English learners working together in the same courses
Jennifer Mayo: @April - we're writing our own K-5 units that achieve NGSS and English Language Development Standards - Portland Public in OR
Jennifer Mayo: @April — it's been a really wonderful writing/ development process and amazing to see in classes. All standards for all students and all students are highly engaged via ELD strategies and focus.

Danny Edelson (he) BSCS: In CA, it's the CU and CSU requirements that drive high school curriculum. Have they been re-aligned to support NGSS?

Carolyn Higgins: I am curious how many science courses are required for graduation in each state? RI currently requires 3, but some at the DoE have suggested lowering it to 2.... I was adamant that should not be a consideration.
Linda Cook: @Carolyn - Texas requires 4 years of science.
Melissa Niemi: Georgia requires 4 years of science
Rae McEntyre: @Carolyn, I think there was a report once put out by Achieve that had that data. At least I recall completing a survey for them a few years ago that included that question.
Sam Shaw: @Carolyn - Achieve, Inc. did a survey in 2018 that looked at grad requirements among other factors.
Heather Cabrera (her/she): NY is 3 and DC is 4 and here's a list of all
Kristin Rademaker: Illinois requires 2 but is talking about upping it to 3. However we are local control so some high schools require 3 now

Aida Awad: Some suburban Chicago districts are even talking 4 years
Heather Cabrera (her/she): this is the achieve 2015 comparison of graduation requirements really does make a difference as does having an exit exam

Bill Penuel (he/him): This is the work infrastructuring activities need to address! How does schedule look and how does this happen that there are shifts?
Maya Garcia: Master Scheduling is a fun fun fun group activity :)

Kate McNeill: "School leaders as the gatekeeper. But can also be the filter and the motivator. " Love this!

Maya Garcia: That's why relationships are so critical to this process

Kristoffer Carroll: @Zoe - "… filter the noise." This is so key. Keeping a focus on the important work is just as important as not getting distracted by the random, shiny "solutions" being pushed.

Deborah Farias: School leaders also need to be the sense-makers...Helping folks to understand the WHY of the multiple initiatives and how they connect and providing the structures and systems to support and sustain implementation

Wil van der Veen: Maybe we can also use labs to USE the concepts

Bev DeVore-Wedding (she/her): @Takako Teaching Higher Ed preservice faculty need to learn that engaging, investigations are valuable learning tools. Your words resonate this idea strongly!

Bill Penuel (he/him): This is one way community partners can help - identifying relevant issues, ways to connect to justice-related concerns. In @OpenSciEd and @inquiry_hub we use interest surveys to help select anchoring phenomena and design challenges for units
Brian Reiser: Echoing @Bill - surveys followed by pilots and a willingness to be surprised by our findings is key to taking seriously building on kids and community interests
Tina M Larson: @ Brian Reiser - yes! Always appreciate how well you encapsulate complex ideas into brief statements. =:)
Bill Penuel (he/him): In @OpenSciEd we use kids own questions from when phenomena are presented to them during piloting to guide revisions — to keep student questions at the center

Ravit Duncan: Listening to children and communities- all children and across all grades

Eric Pyle, NSTA President: Geoheritage projects are another way to engage the community and respect local knowledge

Philip Bell - UW Seattle, he/him: Love the focus on connecting to informal ed through ed leadership! BOSE has multiple relevant report. Here's one that highlighted unique aspects of informal learning environments and a practitioner volume. It is a key place where the "building on interest and identity" piece of the Framework came from...

Ana Chavez: to be able to cover units in a meaningful way within the pacing we have available.

Wil van der Veen: The issues of time may be related to setting priorities within the limited time we all have

Linda Cook: I love hearing about all of the systems that came together within implementation states to support three-dimensional, phenomenon-based teaching. It is a real struggle within a non-NGSS state

with a state board resistant to integrating content, concepts and practices. We have individual teachers and districts working to transform teaching and learning without the state-wide systems of support.

Sue Allen (she, her): Also let's remember community orgs that may become surprisingly strong partners with that youth engagement focus already - e.g. after school, summer, & community youth programs.

Kenn Heydrick: Love the word cloud. Of course, time is in the center, but is a reminder of all our constraints.
Sue Allen (she, her): We've had strong partnerships with afterschool & summer programs who often already lead with youth interests.
Rae McEntyre: I also wonder about the role of professional development when it comes to fidelity of implementation with instructional materials.
Stacey van der Veen: @Rae - I have so many wonderings about this. We find sometimes publisher-facilitated PD focuses on implementing the materials, not the vision.
Nathan Spencer: NIC
Shannon Wachowski: Or even cross-state partnerships and collaborations. :)
Ravit Duncan: Also reduces the "reinventing the wheel" phenomenon in each and every district (and NJ has a lot of them)
Zoe Evans, Bowdon High School: @Rae - In my experience, implementation of instructional materials requires PL prior to the adoption to get teachers as close to the same place as possible and then PL about the materials themselves and finally PL for those identified gaps that all instructional materials have.
Brian Reiser: @stacey @rae in OpenSciEd we think of PD not as "preparing to teach with the materials" but rather as using teachers' engagement with the materials to explore how to support 3D learning for their kids. The materials are the catalyst not the learning objective.
Kristoffer Carroll: @Brian - I can confirm this in implementation with teachers. The material levels the field to then grow.

Neil Lundgren: Cross-boarder collaboration? Shoutout to the Interstate Science Collaborative folk.
Ted Willard: Cross boarder also involves districts within a state looking at other districts in their state.

Kristoffer Carroll: High quality instructional material serve as an essential nucleus for the deeper work to reach the vision of the Framework. I think of the HQIM as a useful scaffold.

Sue Allen (she, her): Also remembering the ACESSE diagram - are we thinking about ways to support multigenerational learning?
Maya Garcia: Yes Sue! Support and integrate.
Philip Bell - UW Seattle, he/him: @Sue—Multigenerational learning has been the hardest equity project to open up in formal ed systems. Not a surprise at some level, but deeply worrying for sure. The informal sector has so much to contribute to help guide that crucial work. To me, it is the best way to make the local community connection that people have been lifting up today.
Rachel Connolly: @Phil regarding multigenerational learning, I have been inspired by the involvement of elders in the Arctic and Earth SIGNs program
Philip Bell - UW Seattle, he/him: Thanks, @Rachel. I haven't heard of that one. (I hope you are well.)

TJ McKenna: Time is the greatest gift anyone can give (for student learning, for teacher learning, to collaborate, to integrate, etc.)

Joseph Bellina: Unless there is authentic buy-in by the teacher, when they close the classroom door, they do what they believe, there prevision ideas

Philip Bell - UW Seattle, he/him: Thanks for lifting up the youth / community organizations, Elizabeth. Community-based environmental organizations have been vital to build teacher capacity to engage youth in meaningful, place-based climate science education. Many of the staff in those orgs were on steep learning curves around NGSS / Framework initially, but they have done amazing work and have become vital partners with our regional ed offices here in WA. You can learn more here

Deborah Farias: Yes! Project management and backwards design action plans that allocate the time and resources are essential to moving from vision to implementation. Quality materials are important and should be part of such an action plan. However, time is a precious commodity and resource that needs to be managed in a very purposeful way.

Brian Reiser: @stacey Not sure they would want that input - that's why so many of us are committed to OER materials that are free for teachers to download. Or to purchase from a vendor who make it cost effective to print hardcopies and deliver kits but leaves the IP alone.
Tina M Larson: @ Brian - yes, that's the difference in thinking that launches the movement toward thinking about teaching in an NGSS aligned way = for the benefit of students! =:)
Danny Edelson (he) BSCS: Publishers are responding to the market. If the market asks them for something different, they will respond.
Bill Penuel (he/him): Following @Brian: We need metaphors of curriculum like "catalyst" to complement those that focus on curriculum as "cause of student learning if taught with fidelity" - it refocuses our professional learning to take this metaphor of catalyst seriously
Rae McEntyre: @Bill I love this. The words we use are so very important and finding the "right" ones to support a message is crucial.
Ted Willard: @Danny As someone who started working for a publisher about 2 years ago, I 100% agree with this statement. I like to say that commercial publishing is research based, but it is market research.
Sue Allen (she, her): @Phil Agreed. And parents' own experiences & attitudes have an extremely powerful role in shaping student's self-efficacy & identities re science. So multigenerational learning can be powerful in multiple ways.
Bill Penuel (he/him): Full talk on this topic of curriculum as catalyst for building collective capacity
Carolyn Higgins: @Danny absolutely! If states require HQIM in science, the publishers will change their materials. RI is heading there, but we are a tiny part of the market.
Danny Edelson (he) BSCS: Selection of curriculum and planning for professional learning should be viewed as two elements of the same decision: the decision to make an investment in improvement.
Gregory MacDougall VDOE: Carol and Danny, we are looking at a HQIM rubric for science in Virginia.
Danny Edelson (he) BSCS: Historically, districts have believed (hoped) that they could improve by investing in only IM or PL. Or by making separate decisions. The systemic nature of education means they can't be separated.
Philip Bell - UW Seattle, he/him: @Danny. I hear the wisdom in your market statement. It so worries me given the transformative work that is needed in instructional materials. Perhaps focusing on a productive segment of the market—rather than an aggregate composite across all places that tends to pull the work away from more expansive approaches—would be important to bring the HQIM market along more quickly. I'm not an expert here, but some curriculum publishers have specialized in this way historically around their approach overall and with specific products.
Danny Edelson (he) BSCS: @Phil, if I understand what you're saying…that publishers optimize over the largest, most profitable market…then you're right. And that's a drawback. We need a business model that looks like local coffee shops, not Dunkin.
Ted Willard: @Phil I think we need to be aware that classroom teachers are often very involved in decisions about the selection of curriculum materials and the default is to select materials that they are

comfortable with. To emphasize an earlier point I made, we need to do more to help a critical mass of classroom teachers understand the shifts that we are looking for, and they need to understand it to some degree BEFORE the district engages in the selection of curriculum materials, not AFTER. (This does not negate the need for intensive Professional Learning after curriculum materials are selected.)

Shannon Wachowski: Everyone is a "science person". And a "math person" and an " ELA person" and a "social studies person" and a …. ;)
Richard Bacolor: You're living through a pandemic, Gudiel. Respectfully, we're all science people.
Bev DeVore-Wedding (she/her): Shared a Jo Boaler TED talk yesterday that said there is not "math" brain. YOur statement is so true @Shannon

James Blake: Using data from the NSSME+ Time study helped us in that time comparison!

Maya Garcia: Takako, I think it would be great to share how the district took that on
Maya Garcia: Or at least share that process with other districts

Heidi Schweingruber: Another shameless plug for a BOSE report -- the new Call to Action for Science Education emphasizes how much science is for everyone. It needs to be seen as fundamental for everyone. "Better more equitable Science education must be a national priority".

Jim Short: Curriculum matters, but how teachers use high-quality instructional materials matters more. Teachers deserve opportunities for curriculum-based professional learning so they can experience the kind of learning we want them to provide their students. Putting on a student hat can help teachers experience curriculum as learners and then focus on planning with the lessons from high-quality instructional materials.
Jim Short: The Elements of Curriculum-Based Professional Learning provide some ways of designing this type of learning for teachers.
Erica Beck Spencer: @Jim short—well said!
Betsy Davis - she/her: +1 Jim -- and giving Ts and PTs the chance to practice using the CM with Ss, including in low stakes contexts (e.g. rehearsals)

Mike Heinz: With generous support from the Carnegie Corporation of New York, 10 states, curriculum developers, researchers, teachers and students came together to develop the gold standard for science instructional material. OpenSciEd has changed the schools that have piloted and adopted it. Now educators work together to support each other virtually.

Joseph Bellina: What are the big differences??

Bill Penuel (he/him): The CSSS professional learning committee came up with some standards that are science specific

Christine Salloom: Sometimes it feels like there's a lot of PD leading up to materials selection and then there's publisher training for implementation, but then the focus shifts to other priorities

Joseph Bellina: How people learn, math science and history…what is the difference
Bill Penuel (he/him): @Joseph: To the extent that learning is in fact a way to support students' engagement in approximations of disciplinary practice, it's really key that the contours of those practices are at the center.

Kevin Anderson: Hmmm... could a phenomenon-based approach have some solid similarities across subjects?

Zoe Evans, Bowdon High School: @Kevin… yes! That would be great… thank you for helping me articulate my thoughts.
Wil van der Veen: @Kevin What if what we learn in school in any subject were related to and usable in the world we live in outside of school.
Bev DeVore-Wedding (she/her): I think Phenomena First can work in more than science @Kevin
Wil van der Veen: @Kevin Phenomena is a fancy term for events in the world we live in and may understand using science

Brian Reiser: It is interesting to think about how to leverage the fact that building administrators see the parallel between the shifts in the Framework and 5D learning and their efforts in math and language arts, without them assuiming that this synergy means that "our teachers know this already - we had PD on student centered learning and culturally responsive teaching so they don't need science specific PD right?"

Jim Spillane: @Gudiel. Important point. Schools and educational systems are being asked to take on a lot of new responsibilities in part due to budget cuts, rising poverty, and a shrinking safety net. We need to talk much more about this

Reflection

- Bev DeVore-Wedding (she/her): I learned that I know some great science people!
- Ellen Ebert: We continue to be stronger when we are a community.
- Tina M Larson: * inability to hear Science Talk in what children say
- Trisha Herminghaus: Collaboration is key to our successes…
- Nathan Windel: Insight: Doing science is a structured approach to being a human in the world.
- Dua Chaker: Importance of focusing Science and Engineering Learning on Justice-Centered Phenomena across PK-12
- Lindsey Roy: Building capacity by connecting to community partners is essential to success of long-term realization of our vision.
- Teresa Lampe: I'm excited to see that other people are struggling with some of the same issues my district struggles with.
- Bill Penuel (he/him): I learned: Ten years in, we still have COLLECTIVE ENERGY for more equitable science learning
- Tina M Larson: * Is the school system pushing kids down from meeting their own expectations?
- Danny Edelson (he) BSCS: My insight for the day was Mike Lach's reminder: Until we increase the overlap between people who understand what good science looks like and people who run schools and districts, we can't make real progress.
- Stacey van der Veen: I appreciated Tiffany's perspective that 10 years is not a long time - I needed that today
- Shannon Wachowski: A valuable vision takes a long time to implement. Change is hard but made easier with collaboration and community.
- Kate McNeill: Anecdotes and concrete examples can be essential for the stories we tell public stakeholders. Keep the language simple, powerful and repetitive.
- Susan Wray: Insight: We must remained focused on the vision and not get distracted by the components.
- Bev DeVore-Wedding (she/her): Also, the importance to integrate intentionally-that is there is some support for mathematical thinking or science thinking but the commonality is thinking!

Sometimes in science we use computational thinking. Sometimes in science the imagination is essential for moving forward. It is important to look at prior work (history) and thus it all boils down to thinking

- Laura Grissom, She/her: Digging into this work together is IMPERATIVE!
- Aida Awad: Reinforced the importance of time for science in elementary grades
- Tina M Larson: * Rethink: "curriculum" as "catalyst", not "cause" for learning
- Tina M Larson: * invest in improvement
- Helen Quinn (she/her): We've come so far, and still have far to go!
- Suzy Loper: Elementary science education is a crucial frontier!
- Amy Himes: We don't organize around vision
  We organize around components
  Keep coming back to the vision!
  Bill Penuel
- Stacey van der Veen: And I also really appreciated the many statements to the effect of doing the standards is less important than using the standards as a lever to improve sci instruction (I think that was Matt K)
- Kristoffer Carroll: Professional Insight: I'm not alone in the work and real collaboration helps us dig deeper in building capacity that is sustainable.
- Philip Bell - UW Seattle, he/him: "By not doing science we are harming people… lives are literally on the line!" — Dr. Stefanie Marshall
- Ted Willard: We are moving forward, but this is a long journey. The key is that we are moving in the right direction.
- Rachel Connolly: Architect experiences that are meaningful to students and locally with students at the table.
- Betsy Barent: I really appreciated the conversation around listening to what students are talking about and 5D.
- Erika Shugart, NSTA: The day has gotten me thinking about implementation curves and where we are on that curve
- Dan Voss: I learned: There's still need for those of us who aren't in policy to connect and engage with policymakers and enlist them as allies
- Stacey van der Veen: Okay one more - we have to help students see themselves in science and as scientists (thank you Stefanie!)
- Danny Edelson (he) BSCS: Another insight: verbing nouns offends me.
- Erika Shugart, NSTA: I also appreciated the reminder of my informal days and thinking about starting with the community and their needs
- Jeremy Peacock: My big takeaway comes from Ted's observation about the rate of change now compared to following the last reform effort. That gives me a little hope when I have tended to be frustrated with lack of progress locally.
- Kim Zeidler-Watters: We have made progress but more work to do. Kentucky. Lots of collective expertise to continue to drive the work.
- Christa Haverly, she.her.hers: From Bill: "We don't do systems-building around vision, we do it around components." I appreciate the push here to re-center vision in system building. And when we center equity in our visioning, that could make a real difference in system building. I remain challenged to consider how to situate this conversation in the context of PK-12 systems that have many other priorities.

- Candace Dunham: Need to focus on labs and allowing students to reveal the content and work on understanding it, not just providing a platform that reveals the content. Need to keep focused on phenomena driving lessons.
- Jennifer Eklund: I'm wondering if there is a role for practicing scientists and other STEM professionals in this collective work. They haven't been discussed as part of the community today.
- Maureen Griffin: 10 years may not seem like a long time, but 10 years of students is a generation. Education needs to do better.
- Meg Richard: From a teacher attending "this makes me realize I'm not alone" <3
- Philip Bell - UW Seattle, he/him: A Take away / Reflection: Uniformity of implementation as an implementation & instructional goal needs to go. Learning is meaningful when it attends to CULTURAL HETEROGENEITY and LOCAL PLACE / COMMUNITY. That has to become our widespread focus.

Richard Bacolor: @Stacy - we need to apply the CCC of scale to our time frames as well eh?

Ted Willard: @Maureen, but the effects of education on a child happen in 13+ years. It is hard to see change in the system in less time than that.

Deborah Batzer: Where are you finding PD?

Deb L. Morrison: Thanks to all who presented today and for all the great shares in the chat. Big 🤗to all. ++ on equitable and just partnerships is the clearest common message I've heard here today.

Maya Garcia: And even what counts as science outside of the classroom :)
Deb L. Morrison: +++ on expanding what counts as science!

Bruce Alberts: To pick up on Ted's point, how about scheduling monthly sessions focuses on continued community building and sharing. I have found the chat box incredibly inspiring with respect to the team building that we need for success over the long term.

Meg Richard: I love that @Heidi- then what sustains us sustains each other.
Mark Meszaros: +1 Heidi! Community is so important and invigorating.
LeeAnn Mikkelson (she/her): There are also different zones in gardening....
TJ McKenna: +1 Heidi! Gardening is my favorite way of carbon sequestration!
Lindsey Roy: Nature seriously takes the long game that we can see through ecological succession! Moving from solidified rock to fertile soil. How can we develop rich soil in our communities?

Einstein Project: I think about the progress that happens in some districts and how many more need to pick up the work. I am thankful for your contributions and look forward to continuing the progress with you!

DAY 2

Wonderings/Centering Students Experiences Panel

Helen Quinn (she/her): Would love to see some district by district or county by county maps of the country showing what has happened in terms of science standards implementation, not just adoption.

Carol O'Donnell (she/hers), Smithsonian, Washington, DC: These Design Elements remind me of the 5 pillars of the LASER model (Leadership and Assistance for Science Education Reform): https://ssec.si.edu/laser-model
Tom Peters: I agree, Carol.
Philip L Bell: Thanks for making that connection, Carol. After Elizabeth's presentation yesterday I've been thinking about what I think is the largely untapped opportunities to partner with the informal science ed sector at the community level in relation to the Framework vision. I'd be interested in getting a better landscape view of if / how that has been unfolding across the country.
Jake Foster: @Phil. An organization I work with here in MA (https://www.wadeinstitutema.org/) partners with informal ed institutions across the state to support inquiry-based place-based PD in the mode you are thinking about.
Joseph Bellina: Phil, do you know about the DOS program at Harvard that seeks to evaluate out of school programs.

Mary Starr (she/her) MMSLN, MI: If you would like to join - The Michigan Math and Science Leadership Network is organizing post-summit discussions, October 19 and 26. Feel free to join us by registering here: https://tinyurl.com/MITakingStockDiscuss

Deborah Batzer: We are starting next year so I am hear to gather all aspects of implementation.

Maggie Mae Skyler (her/she): I wonder when our science standards will allow for hands on testing for state science exams

Heidi Schweingruber: How do we maintain coherence in a distributed system of systems?
Michael Lach: Heidi, I'm less convinced that coherence across systems is nearly as important as coherence within (school) systems.

Helen Quinn (she/her): What does implementation look like county by county across the country?

Bill Penuel (he/him/his): How do we build bridges with leaders across levels of the system who are not focused on science? What do we need to learn from them, and how can we learn with them?

Ward, Terry: I wonder how states like Texas can push 3 dimensional learning beyond the new standards being adopted?

Megan Rivard, Central WA: How can I best support those educators who are still reluctant or hesitant to adopt NGSS?

Lindsey Roy: Who is in my "community" that can support the work to building a richer tapestry of 3D Science Teaching and learning?

Betsy Barent: How might we leverage the experience of veteran teachers who have lived through various iterations of student-centered approaches to teaching science?
Tina M Larson: @ Betsy - yes. =:)

Suzy Loper: What should we change in the next round of standards revision, based on what we have learned from this implementation? (One example: will we consider specifying grade-level standards at middle school (rather than grade band), to support more coherent development of instructional materials at this grade level?)

Brieann Trueblood: My wondering is how to network with all of these wonderful people to help my district think through implementation roadblocks!

Christine Murphy: How do we help shift instruction from telling the kids information and then they do "labs" to prove what they "learned"?

Eric J Pyle, NSTA President: How do we convince people that systems change efforts do not lead to deterministic outcomes, but lead to different patterns.

Meg Richard: I am wondering about teacher voice in this work- I'm excited to see a MS teacher on this next panel but wonder how we can better elevate the voices of the implementers in the classroom?
Maya Garcia: @Meg, we are hoping to do some more engagement with educators from January -April
Shannon Wachowski: @Meg-Thanks for naming that. I've been wondering that as well. Glad to see there are plans in the works for this!
Maya Garcia: @Meg @Shannon, you know me better than that :)
Meg Richard: Never doubted it Maya <3

Tom Peters: I am wondering what we will do this time to have more impact on science education than we did in the 1990's-early 2000's. So many of the challenges of today are the same as they were 30+ years ago.
Wendy Binder, NSTA: @ Tom-- agreed :)
Tom Peters: @Wendy…I am having deja vu all over again.

Liz Wolf: How do I support teachers and principals with a brand new implementation of NGSS in a state that has used the framework to write their own standards?

Philip L Bell: Reflection: At what level should we be centering "coherence"? I heard a fair amount of talk yesterday about the need to center on community history & interests. Should coherence be focused on how the community views the science educational experiences in that sense? Do we need to deepen on our focus on community accountability in the work?

Susan Wray: How do we motivate "unfreeze" teachers to begin the process of shifting to NGSS and then support them through the change process?

Candace Dunham: How can I support teachers in lower grades to better expose our students to 3D - getting buy in the we can address ELA and Math skills and content through Science.

Amanda Collamore: I am wondering how to support teachers that are required to follow box curriculum in the elementary/middle school levels, instead of being encouraged to have hands-on, explorative learning opportunities to meet the needs of the specific students they are teaching?
Maya Garcia: @Amanda! Great question!
Maya Garcia: We hope to take that up in our discussion on Dec 8 as well!
Stacey van der Veen: 👏Amanda!
Megan Rivard, Central WA: @Amanda Great wonder!
Wanda: @Amanda I would say teacher expertise in knowing how/why to modify boxed curriculum matters.

Kate Goss: How can philanthropy best support equitable, deep student engagement in environmental science?

Michael Lach: Bill, let's talk about building bridges. Part of that I think means being much more incremental in what we want and expect vis-a-vis science.
Maya Garcia: @Michael, it is going to be essential to supporting and catalyzing momentum
Michael Lach: @Maia, I'm less convinced of that than I once was. Let's chat.
Maya Garcia: @Michael, I would love to!
Richard Duschl: Bill and Michael - I would welcome being part of that conversation. As Bill knows here at SMU we are engaged in building and studying a preK-8 Model STEM school adopting continuous improvement frameworks.

Wendy Binder, NSTA: I wonder how we can help shift HS classrooms-- such a different culture to tackle
Megan Rivard, Central WA: @Wendy same!
Margaret Carrera-Bly (VT AOE) she/hers: +Wendy, each level has different challenges for sure.

Suzy Loper: How is it possible, practically, to support teachers in customizing/responding to their local communities and student cultural background, without expecting them to design their own curriculum?
Kate McNeill: +1 Suzy. Yes! Customizing curriculum for their context
Kevin Anderson: @Suzy - the ACESSE research project (led by Phil Bell) is tackling that issue right now. I know the group hopes to share some resources in the next year.
Suzy Loper: Thanks @Kevin!
Philip L Bell: Thanks, Kevin. // @Suzy: It connects back to things you and I have talked about in the past, but the 7 equity projects we named yesterday are being opened up into learning pathways for science educators with a focus on instructional materials adaptation and assessment. The cultural pedagogies pathway is centered on community history, interests, & practices (and may intersect with other equity projects). Stay tuned. (I hope you are well.)

Rachel Cohen: I am wondering how we can organically embed social justice and diversity in our NGSS units so that the students wonderings and figuring's take the lessons to these key points
Maya Garcia: @Rachel, we worked with our Env Ed partners in DC to develop curricular resources to support that type of implementation
Dua Chaker: Yes Rachel great question!
Sara Cooper: +1 Rachel

Maggie Mae Skyler (her/she): With being outside we as science teachers and schools as a whole have to realize that science takes practice. Doing science outside might not be what you expect as students might not have done this yet ever

Amanda Collamore: Also, I'd be interested to learn more about inclusion in the classroom for students who have disabilities/impairments (hearing/sight/physical) to encourage immersive activities built for typically developing children.

Kelly Carey: What are the creative models for continuing to optimize implementation efforts with teachers in light of a lack of guest teachers/subs? (Models of job-embedded PL)

Darcy McMahon: How can we center student experiences without completely re-writing curriculum for each new group of students? This seems especially important at elementary where teachers are not necessarily content experts in science.
Margaret Carrera-Bly (VT AOE) she/hers: @Darcy We can address student-centered learning by developing authentic and engaging assessments and units. I like to think that though the “what” remains the same, the “how” is where student authentic learning shines. (especially if our what is free or bias and attends to justice)
Suzy Loper: And yes @Darcy — especially a lot to ask of elementary teachers, but of all teachers!
Maggie Mae Skyler (her/she): Practice with purpose is important for science classes.
Darcy McMahon: @Margaret, Yes you are absolutely right, and it is so tied up with the conversation between Edna and Rabiah right now too. It is just challenging from a curriculum design perspective to allow the "what" to be flexible enough for the "what kids bring" to shift and become more relevant to students experiences while still remaining the "what" and allowing for elementary teacher comfort level with teaching it.
Ward, Terry: +1 Darcy

Ravit Duncan: “equity” [is used] to address ways—through changing policies and practices—of removing barriers to participation in science and engineering and increasing achievement, representation, and identification. “justice” refers to addressing systemic oppressions that cause those barriers, thus seeking fair treatment of all people and supporting opportunities for self-determination and thriving.

April McCrae: I LOVE THAT YOU ARE IN THE BUILDING WITH STUDENTS <3
Meg Richard: +100 April!

Amy Trauth: I’m glad that Rebiah called this out. Many of us are in our schools with students. Right now.
Maya Garcia: +1 Amy
Megan Gambs: Thank you, Rabiah.
Maya Garcia: +1 Rabiah
Julie Ballance: Yes yes yes, Rabiah!
Margaret Carrera-Bly (VT AOE) she/hers: ++++
Stacey van der Veen: Yes yes and yes

Kevin Anderson: Edna and Rabiah, love your practical questions and thoughts about implementation in the classroom!

Elizabeth A Davis: Love the idea of giving units the space to breathe, to help us center students and their experiences! This is such a huge issue for preservice teachers!

Cindy Bunch: @Rabiah, you are so right! Teachers need the time to plan effectively.

Ward, Terry: How do we then support the teachers who aren't experts?

Richard Bacolor: Yes Rabiah! Fix spaces not people.
Carrie-Anne Sherwood: @Rich @Rabiah - is this the "infrastructuring" we heard about yesterday?

April McCrae: It demands that administration be coached in the support of teacher autonomy within a construct of focused learning

Amanda Collamore: I think it is important, too, when making these decisions, teachers are encouraging and fostering growth through an innovator's mindset. The innovator's mindset will not only help students grow in the science classroom, but also help student's growth in other subjects and encourage the ever important soft skills including communication and problem solving skills.

Amber Carter: The experiences the students are bringing into your classrooms are so incredibly important to understand... it is in this understanding that we can truly elicit student responses while teaching by making connections to their real lives.

Leslie Silbernagel: Check out the Synnovations Lab at Sycamore Schools in Cincinnati for an interdisciplinary format for high school. https://www.sycamoreschools.org/domain/910
Eric J Pyle, NSTA President: @Leslie, this Synnovation Lab looks cool!

Liz Wolf: Science is everywhere and need to be authentically connected!

Wil van der Veen: Great example Rabiah, We need to help students connect the science (or anything else) they learn in school to their daily lives and interests. Despite our own science education I have fund that we struggle to identify the science in our daily world because this was never done for us.
Maya Garcia: @Wil, so important to elevate!

Ravit Duncan: Expanding what counts as science.

Philip L Bell: Reflection: Making time for learner's life experiences also directly relates to the narrowing of the content of science we expect to be taught as a science / science ed community — which is very complicated work when it comes to setting standards. Pacing guides are driven by "coverage" of all standards. I've had teacher colleagues in tears because they were being told to "speed up" instruction—and it was coming from an enforced pacing guide that was built from the grade-band of standards. How do help make space for curriculum units to breathe by narrowing what we expect to be taught?
Darcy McMahon: +1 Phil - so true!
Helen Quinn (she/her): Responding to Phil in the context of this panel
Rae McEntyre: @Phil--I've thought about this, too. The "coverage" discussion, for me personally, is what is troubling. I don't see standards being covered but an "end goal" (I struggle with the right word here). I think it was Matt yesterday who said something like standards being the framework (sorry if I mis-represented, Matt). I think this why understanding core ideas is a key, but because these are "broken down" into standards, it becomes a coverage discussion.
Brian Reiser: @Phil agree completely - when working with partner districts adopting new instructional materials this is a real challenge - they are often not coming to the table thinking about the fact that change is gradual and it is better to engage in the kinds of discussion to really bring in students

experiences and interests than to adhere to the estimates of #lessons timing estimates in the teacher guides. And some teachers as well feel like it's a "6 week unit, I need to move on"
James Emmerling: @Phil, I think one way to bring focus on allowing curriculum to "breathe" is to ask teachers to focus on why they are teachers.
Brian Reiser: +1 James
Darcy McMahon: +1 James and Brian

Tina M Larson: Science is Everywhere & need to be authentically connected. If we can get Ss to understand and integrate that into their thinking, that next generation of Parents (!) can help raise their next generation students. =:)

Ravit Duncan: It takes partnerships to do this important and challenging work

Leslie Silbernagel: bring students into the conversation
Julie Ballance: +1 Leslie!

Amy Trauth: Thank you, Maria! Our work in STEM cannot be so laser-focused on workforce preparation.
Maya Garcia: +1 Amy
James Emmerling: +1 Amy

Eric J Pyle, NSTA President: @Maria - this is at the core of the neoliberal approach to STEM education. And it is not holding up well.
Helen Quinn (she/her): continuing... how can we convince administators and assessment designers to focus on the development of practices and engaged participation over measuring bits and pieces of knowledge gained?
Maya Garcia: Well said Maria!
LeeAnn Mikkelson (she/her): Wow- to all.
Mary Starr (she/her) MMSLN, MI: @Maria thank you for saying out loud the issues surrounding "STEM as workforce development".
Darcy McMahon: +1 Helen and Maria
Maya Garcia: @Mary, I think that was really well stated, because it is such a huge tension in the field. On one hand we want to be connected with efforts and conversations between workforce and ed sector are really important, but one voice tends to weigh more heavily than the other in terms of influence, and that is where the imbalance is

Wanda: STEM to dismantle and disrupt oppression
Stacey van der Veen: +1 Wanda

Amanda Collamore: I have found, when trying to introduce immersive learning opportunities into classrooms, that teachers who have been in the classrooms for many years (maybe nearing retirement) are less comfortable making changes to how they have always one it. How do you help teachers refocus and learn to adapt their classrooms/curriculum to begin including the everyday life connections? To create more hands-on, immersive experiences when they've been using curriculum required by the school boards/administration?
Tina M Larson: Amanda - I hope you put that question about veteran teachers in the Q&A! =:)
Amanda Collamore: @Tina, I did.
Tina M Larson: =:)

Tina M Larson: Well put, Maria! The ripple effect of Tt practicing equity in their classrooms not only gives voice to each of their Ss but changes the lens of how Ss of the 'Dominant Culture' will come to view the world around them for the rest of their lives! =:)

Ravit Duncan: Brilliance of students
Julie Ballance: #handsonmindson
Leslie Silbernagel: Rabiah - I love this idea of a student's personal science history, Just by living in their world they have a science history but students don't realize it and teachers don't acknowledge it
Wil van der Veen: Exactly Lauren hands-on should lead to minds-on
Wil van der Veen: Minds-on can be fun and interesting and we can share that with students
Brett Moulding: Relevant science does not mean hands-on only. Lauren, I like the idea of thinking about what students are doing that are relevant.
Meg Richard: Yes Lauren- so much of the hands on that they love/d, I'm hearing has to do with that being the opportunity to engage in discourse with their peers.

Deborah Farias: Any resources to share for surveying students to capture their voices with meaningful data to center their experiences and include their voices into the curriculum?
Maya Garcia: Carol's Ted Talk
Bill Penuel (he/him/his): @Deborah, we use student electronic exit tickets linked to our @inquiry_hub and @OpenSciEd curricula to elicit student experience, and work with teachers to formatively use those data to address inequities in student experience

Kelly Carey: What about this analogy: Do we want students to be cooks or chefs? Cooks often follow a scripted recipe. Chefs know how ingredients work together to create a meal. We want students experiences provide an onramp for discovery, not confirmation of what the teacher told them. The Shift: From "Do to Confirm" to "Design to Discover" This is what I'd want to hear from students as their experience doing science .....
Maya Garcia: @Kelly I love that analogy!

Kevin Anderson: Thanks, Maria, for recognizing the trauma.

Liz Wolf: Yes, the system has been doing what is was designed too. It's time to redesign the system.
Wil van der Veen: Agreed Marie; what exactly did we loose?
Gina Heineman: There has to be a shift in the way education majors are prepared to teach science.

April McCrae: The simulization of science is a sad side effect of Covid. Kids and humans need to interact with real time and real world experiences as much as possible to understand and connect with content and practice--otherwise the learning is temporary and "artificial"
Amy Trauth: @April, agreed. Too many students came back to school, only to sit at their desks to run simulations.

Kevin Anderson: +1 Maria! I wrote a bit on "learning loss" a while back, centered on the purpose of learning
Ravit Duncan: Learning loss rhetoric dehumanizes students, teachers, and families
Lindsey Roy: +Kevin great post.

Philip L Bell: +1 James. I worry deeply about teachers who feel their jobs / career paths are on the line in relation to how they respond to the constraints placed on instruction by administrators. I've seen a lot

of creative freedom to support meaningful, deep learning by teachers, but they had the freedom to make those principled, professional calls about how to spend instructional time.

Ashley Smalls: I agree Maria!!! The focus too much on learning list vs the what we learn from this transition

Suzy Loper: I see people expressing valid concerns that districts and teacher are focusing on "coverage" -- but to the creators of the NGSS: what did you expect would happen when you provided a long list of DCIs and PEs? I don't think we can blame this on the states, the districts, the assessment developers, the review tool developers, and certainly not on the teachers. If we don't want stakeholders to worry about "covering" the long list, we shouldn't provide a long list. It seems like a very predictable result of the number of standards in the NGSS.
Stacey van der Veen: @Suzy, refocusing on using multiple Core Ideas to explain phenomena instead of looking at each individual performance expectation as an independent “lesson” takes away this overwhelm
Heather Johnston: +1 Stacey, bundling standards is so helpful
Wil van der Veen: @Suzy - maybe the problem is in the way we approach this list. The number of Core Ideas in NGSS is much much thinner than any HS science book in which the foundational ideas in science are lost
Tom Peters: @ Suzy I agree…and we have to remember that many of our teachers are wrestling with multiple standards documents…not just science.
Ted Willard: @suzy I share your frustration. As NGSS was being developed, NSTA's feedback was that there were too many DCIs. That said, NGSS still represents less content than was typically expected in earlier curricula.
Kevin Anderson: @Suzy, I will also share the sometimes unpopular view that relevant, community-based science learning that engages kids meaningfully in building a scientific identity (and sparking joy) is more important than getting to all the DCIs.

Patty Brown: Not long ago I learned from a young man I met that at university that once had a very robust science program, the chemistry class had shifted to simulations rather than the real deal. And not just for things that would be hard to replicate in a lab.

Lana LeBlanc: As an African American practicing engineer with 20+ years of experience in various industries, I can attest to the need to bring everyday life experiences into the classroom. Science is everywhere and I am science. I know that! It is a paradigm shift in one’s mindset that needs to happen and it can happen in the classroom.
Leslie Silbernagel: +1 Lana

Helen Quinn (she/her): Simulations have a valuable place, allow students to visualize things inaccessible in the classroom, but cannot be the only experiences of phenomena that students experience
Amy Trauth: @Agreed, Helen. Sims helpful for visualizing phenomena at very small and very large scales. Over reliance on them as a substitute for firsthand experience is misdirected.

Kenn Heydrick: +1 Maria - collaboration has definitely been enhanced by our current situation. Look at this chat!!

Patty Brown: The bundling resources associated with the NGSS are useful. And more and more thoughtful teachers are sharing their ideas for grouping DCI’s.

Patty Brown: In reviewing our state standards for listening and speaking, I think science experiences could help teachers meet these goals.
Wil van der Veen: @Patty - yes we should always bundle the DCI's (core ideas) because I cant think of anything that can be understood with one Core Idea. As long as we do things in school one-by-one students will not see the important connections and it takes so much more time

Enrique Suarez: Turns out constructivism applies to teacher learning, too
Kate McNeill: +! Enrique. Yes!!!

Rachel Connolly: I think the conversation around simulations and digital phenomena/data is different for the Earth and Space sciences (and really demands different design and pedagogy across the different domains)

Jess Harris: I'm working on developing a grant for a center of excellence and I needed to hear this discussion today. Thank you.

Christine Salloom: There may be less DCIs but it takes MUCH longer to build the 3D understanding than to 'cover' the old laundry list.
Philip L Bell: Here's a brand new STEM Teaching Tool that Enrique helped co-author related to the point he just made: How can we confront and dismantle systemic racism through science learning?

Danny Edelson (he) BSCS: I am troubled by the fact that while we have a panelists discussing centering students' and teachers' actual experiences, we have a chat thread focusing on the nature of the standards. Are we modeling respectful listening?
Tom Peters: @Danny. I think we got on standards in recognition ow ways in which they take student and teacher experiences off center.
Brian Reiser: @Tom thanks for bringing us back to that. I agree. There can be a perceived tension between the # of "standards" in NGSS and the goals of the Framework, which very much build on the idea of helping students connect what they are figuring out to what they, their families, and communities care about.
Maya Garcia: +1 Brian
Philip L Bell: +1 Brian — we can't attend to the centering of student and community lifeworlds & interests without exploring the inequities caused by standards
Heidi Schweingruber: @Danny -- I appreciate the concern about chat distracting from the speakers. We have enabled full chat during this meeting so that people can engage in the modality that works for them. We have 280 people in the event. I suspect that a small subset are working in chat versus listening to the panel.
Brian Reiser: @Phil agreed
Dina Lemmer: 100% agree Brian and Phil. Teachers do not feel like they have enough time to provide authentic science learning experiences for students and still manage to get to everything. (sorry, I'm slow to typing today!)

Mike Heinz: catalytic points of disruption 👍

Helen Quinn (she/her): If you can think of performance expectations of exemplars of what students should be able to do (perform) and guide your teaching by that then all this works. I know that assessments currently drive teaching in a different direction, so a critical piece of this is moving to different ways of assessing student learning eg portfolio or performance based.

Maya Garcia: +1 Helen
Juan-Carlos Aguilar -GaDOE: Agree Helen

Wanda: @Darcy: centering students-might this tool help? http://stemteachingtools.org/brief/31

Tina M Larson: Love the Loo example!! =:)

Ted Willard: Just as we advocate focusing on the assets students have rather than having a deficit model, I find it helpful to do the same when considering what is going on in classrooms and the education system overall. There are clearly huge problems in education, but I think it is helpful to focus on where we have successes and think about how we can build on those successes.
Linda Cook: @Ted I love that asset approach.

Kevin Anderson: Love that "tofu of the curriculum" :)

Patty Brown: I have found that being connected with current events around things happening all over the world, then bringing the idea home to see how the problem manifests in our little tiny Alaska town. One example is beach trash. Students are fascinated with the Great Pacific Garbage Patch. A walk along the shoreline here shows how plastics persist. Then learning about the young Dutch man working on a solution for cleanup and anyone can contribute ideas for how to stop or slow the generation of ocean garbage.
Amy Stephens: @Patty I really like that example and connection!

Jess Harris: These examples straight from classrooms are very much appreciated!
teresa Lampe: Connecting learning to students experiences is the piece that most classrooms lack!

Philip L Bell: “Onramps to disruption” — Edna Tan // Love that!
Christa Haverly, she.her.hers: We need examples like what @Edna shared in video form like @Lauren mentioned to be able to demonstrate what’s possible in multi-modal ways and support teachers in learning how to do this work.
Edna Tan (she/her): @ Phil Bell -Onramps then we build highways!
Brian Reiser: I love @Dr Tan’s example and it’s super relevant for the discussion about not losing the ideas of the Framework in too literal interpretation of the very specific combinations of practices and ideas articulated in the NGSS PEs.
Amanda Collamore: +1 Edna and Phil
Kelly Carey: @Edna : In this example the teacher is comfortable with not having the lesson plans fully fleshed out each day. The process of lesson planning actually pivots to be daily teacher reflection based on students ideas in each hour/class. I have found this to be challenging practice for teachers to make a shift in....their past practice has been that they have lessons fleshed out based on what THEY want to teach, not driven by students ideas.
Philip L Bell: 💚💚💚 @Edna
Kate McNeill: +1 “on ramps to disruption’ Love Edna’s example!

Edna Tan (she/her): @Kelly - agreed. The teacher had a lot of support - we did PD with them (same group, only 3), extensively in the summer and in the months leading to enacting this curriculum. We co-designed the curricular materials (PPTs, handouts, etc) and we were in the classroom with them throughout as co-teachers etc. It takes a village. It has to.

Todd Campbell: Love Dr. Tan's example as it focuses on humanistic pursuits through engineering - distant from focus on meeting a challenge put forth from external resource holder (contractor) and capitalistic aims [aim not global competitiveness, instead nurturing human dignity]

Wanda: Improvisation absolutely

Ted Willard: I like to say that teach NGSS is much more like improvisational jazz than it is like a piano concerto
Patty Brown: @Ted I like the metaphor.
Heidi Schweingruber: +1 Ted
Maria Olivares: @Ted, love that
Amy Trauth: And also, district administrators expect them to have lessons plans…
Maria Olivares: @Ted, love that!
Carolyn Higgins: +1 Ted! All improv
Bev DeVore-Wedding (she/her): +1 Ted and unfortunately some administrators do not jazz!

James Emmerling: Great question! Teachers are not expert curriculum writers. Improve is wonderful but do they know where and when it is appropriate? How does it impact coherence in the curriculum both horizontally and vertically?
Ted Willard: @James We need curriculum materials that support that flexibility.

Amy Trauth: Thank you, Enrique, for acknowledging the range of expertise among teachers.
Eric J Pyle, NSTA President: @Enrique - yes - Induction is often overlooked, and should be an extension of preparation
Christa Haverly, she.her.hers: @Enrique I love the idea of PLCs with teachers with varying levels of experience

Helen Quinn (she/her): California early implemter project had some indication in their data that this kind of science teaching in elementary classrooms correlated with higher reading and math scores -- we need to gather this evidence and publicize it to elementary proncipals and other decision makers
AR STEM: +Helen we need those data
Kimberley Astle: @Helen, is this published? Do you have a link?
Helen Quinn (she/her): Not sure it is published -- I was talking with some of the teacher leaders of that work -- I will try to find out. But we need to gather such evidence if we can.

Rachel Connolly: Do stories like Edna's become the basis of more usable forms of educative curricular materials?

Deborah Batzer: The largest concern is that the teachers are now coming in through alternative programs, how do we enrich their practice indirectly? What resource is out there that they could se to learn from? Is there a universal model they could use to learn?

Carolyn Higgins: @Bev- My last admin wanted me to write daily objectives on the board. I brought a relevant STEMTeachingTool to her and discussed options I could use instead. She was ok with having our focus question instead.
Bev DeVore-Wedding (she/her): Computational thinking-one reason I have been told not to teach STEM but separate science and math...

Amanda Collamore: Sometimes I think the problem is students are taught curriculum development and lesson planning in teacher preparation, but then, when the pre-service teachers enter the field, they lose some of those skills because box curriculum is pushed into the classrooms and teachers are not always allowed the flexibility to adaprt the lesson plans
Amy Trauth: Also, @Amanda, PSTs often aren't afforded enough opportunities to practice modifying or adapting curricula
Amanda Collamore: +1 Amy. I completely agree.
Wil van der Veen: @Amanda - That may be part of the problem. Teachers also need time and "space in their minds" to plan and modify as needed
Amanda Collamore: @ Wil, absolutely.
Kevin Anderson: Agreed, Amanda. Administrators often want teachers to maintain fidelity to those boxed curriculum materials. The flexibility of teachers creating completely new units is a challenge for many reasons. Adaptation to local, while still maintaining fidelity to the principles of the materials, might be more tenable with administrators.
Carolyn Higgins: +1 Kevin

Jess Harris: Claps for that teacher - That is a beautiful creative inquiry question "How do social movements connect with ways of undestanding motion in physics?" Thanks for sharing Maria!

Kelly Carey: Can the tension be named between "common curriculum" and "flexibility and choice?" My perception is that common curriculum is an adult-driven decision for PL, calendaring, evaluation etc. Flexibility and choice looks more like a curriculum structure, but flexible pathways. This tension is real as district leaders want commonality, teachers want autonomy yet meaningful collaboration, and students are most invested in their personal interests related to phenomena and problems.

Maria Olivares: The work I was referring to is with colleagues Eli Tucker-Raymond (BU) and Brian Gravel (Tufts) for the Re-Making STEM project

Edna Tan (she/her): The engineering curriculum I shared about could be found on engineeerIam.org

Gavin Fradel: Equity and justice can be the simple act of ensuring each student has the materials at their desks/tables for classroom learning and instruction.

Amanda Collamore: @ Kevin, what I have found is that administrators are really focused on all of the students receive the same information the same way and forget about catering the experience for the individual students. This is what happened in our local school district
Stacey van der Veen: @Amanda we also see that with teacher professional learning - admins often prioritize everyone getting the same PD over individualization by need

Maya Garcia: Chat question: What strategies have you seen or have you used to center the student experience?

- Wanda: https://ssec.si.edu/vaccines
  Carol O'Donnell (she/hers), Smithsonian, Washington, DC: @Wanda - thank you for pointing out that the Smithsonian Science Education Center has tried to integrate strategies to center student experience in our instructional materials. In particular, we developed a graphic to show that there are 4 components to teaching science: empowerment and agency; equity and justice; open-mindedness and reflection; and local and global connections.
- Brian Reiser: https://www.openscied.org/covid-19-health-equity/

- Richard Bacolor: Dr. Christopher Wright shared some amazing examples of student-centered engineering with us at MSTA last year. Really. So good.
- Lauren Kaupp: Here is one resource with a Hawai'i example
- Jen Lewin (she/her): http://learninginplaces.org/
- Bev DeVore-Wedding (she/her): Place- and project-based topics and learning opportunities help center the student experience. Engaging students' life and work experiences to frame content
- Ravit Duncan: Some wonderful curriculum materials and tools: STEM teaching tools
- Ravit Duncan: More resources- Tools for Ambitious Science Teaching
- Jess Harris: Design thinking model: https://www.edutopia.org/blog/teaching-empathy-through-design-thinking-rusul-alrubail

Deb L. Morrison - UW: Thank you Edna for the reality check on our responsibilities.
Jody Binz: @Edna...appreciate the comment about wicked problems...

Stacey van der Veen: I so appreciate the urgency that this panel is putting front and center

Amy Trauth: How do we help inservice teachers both understand and plan for coherence from the students' perspectives while also attending to their interests and needs? This seems like a huge ask.

Patty Brown: Developing a good relationship with social studies teachers might be a good way to approach the problem-solving aspect of science learning. Where are the schools with inadequate ventilation? What children are the most exposed to lead-polluted water? Are indigenous people allowed to pursue cultural traditions like proxy hunting for elders?

Tony Perry: One theme I draw from (and heard here) is to emphasis process over product. This makes space for students to bring their interests and identities into the classroom

Ted Willard: When I was at Project 2061, one of the things I enjoyed was that we were focused on long term reform. So many initiatives were about changing things in a couple years. We were looking out decades. I don't know who is doing that today

Kevin Anderson: "What are the catalytic onramps of disruption that I can do right now?" - thank you , Dr. Tan
Edna Tan (she/her): Thank you Kevin
Jody Binz: @Kevin...ditto!

SLIDO
Lauren Kaupp: Hard to choose one, because the shifts are interconnected!
Philip L Bell: Or Option (H) Overlapping science instruction with the cultural lives of students, families & communities
Sharon Cates-ID: +1 Lauren.
Melissa Mendenhall: I agree Lauren.
Amber Carter: Putting students at the center... becoming a facilitator and allowing students to use their own thinking and knowledge to determine the path they take.
Ted Willard: Interesting to see my choice one of the least popular. (I just might be different than most people) ;-)

Kate McNeill: Coherent from the student perspective.
Jess Harris: @Phillip Bell - suprised to not see that option o the poll!
Christine Salloom: Letting go of old methodologies and figuring out how to grade when your focus is more intangible than a worksheet or other work project
Christa Haverly, she.her.hers: Option I: Letting go of control - being okay with uncertainty in the classroom
April McCrae: +++++++++Christa Haverly
Wil van der Veen: @Ted We may be underestimating how challenging these practices are for most teachers
Diksha Gaur: @Ted Willard my choice was also at the bottom!
Ted Willard: @Wil These shifts are very hard. It is important to keep that in mind as we plan.
Jess Harris: @Diksha - I'm sure we'd all agree that they are ALL challenging shifts, picking just one as most challenging depends on your context - they all deserve attention and have value

Matt Krehbiel: Biggest challenge—not othering or taking on a deficit mindset about the various players in the science education system.
Stacey van der Veen: +1 Matt
Maya Garcia: +1 Matt

PROFESSIONAL LEARNING SESSION
Deb L. Morrison - UW: Thanks so much to NSTA for working with us to think about how to address emergent needs for resourcing climate justice learning
Kate Goss: Yes, Deb! Climate Justice!

Richard Bacolor: I wonder if that TIME word actually means “planning” at 6-12 and “instructional” at K-5? Probably?
Lauren Kaupp: +1 Richard, absolutely!
Erika Shugart, NSTA: @Richard yes!
Amber Carter: There are so so so many elementary schools who don't get a specific TIME period to teach Science.... at most, a lot of them have to interchange Social Studies and Science.
Erika Shugart, NSTA: @Richard at the HS level it was about having the time to teach "hands on" phenomena based learning
Jess Harris: When I taught 5th grade I was alloted 45 minutes to teach science every other day (switched out with social studies)
Kate Goss: Planning and prep in lower elementary grades is limited, so it may mean both.
Heidi Schweingruber: @Richard -- time also emerged yesterday in the word clouds of challenges. I assumed it meant different things at different levels.
Lauren Kaupp: The time crunch is very true at middle school as well, when students haven’t had an opportunity to learn science in elementary
Maya Garcia: +1 Heidi, we heard it referenced in multiple ways

Danny Edelson (he) BSCS: I wonder what it means that “students” is listed as a biggest challenge at middle/high.
Mary Weller -MSDE-: @Danny Edelson, that is an excellent question. Concerning.
Ted Willard: @danny I think that means that the appearance of the word "students" does represent a challenge, but probably not the one that the people who chose it meant.

Maya Garcia: Everyone plays a critical role in this process, and we have some stellar examples of this working well in some cases.

Deb L. Morrison - UW: +++ on coherent professional learning resourcing, funding and sustained engagement.

Heidi Schweingruber: I am so pleased to see "relevant to local community and students' lives" so high on the list!
Wendy Binder, NSTA: @Heidi We were as well at NSTA!

Wil van der Veen: I think an additional challenge may be that very few (if any) have never learned science this way.

Christa Haverly, she.her.hers: Are results from this survey available somewhere? Would love to be
Maya Garcia: We will have those up online Christa

Tom Peters: I would love to see a longitudinal look as surveys about science education. My hypothesis is that the lists from the 1960's, 1990's and now would be nearly identical.

Kate Goss: Exciting to hear about your environment ed/climate activism partnerships.

James Emmerling: +1 Principled revisions

Dua Chaker: Very fascinated by your work Melissa!
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: Smithsonian Magazine article that builds on Dr Braaten's comments: Learning Science at Home
Wendy Binder, NSTA: thanks Carol!

Deb L. Morrison - UW: Rehearsals came out of Teacher Education by Design

Carol O'Donnell (she/hers), Smithsonian, Washington, DC: Love Dr. Campbell's use of identity mapping!!

James Emmerling: Can someone post Equity Discourses, please?
Todd Campbell: Equity Discourses in Science Education (Philip & Azevedo, 2017) (10 mins) [4:30-4:40]
(1) improving students' achievement, access, and inclusion in school science by "fostering connections to classroom disciplines and promoting personal relevance" (p. 528),
(2) increasing students' interest in and identity with science,
(3) broadening what counts as science by making visible the "diverse ideologies and epistemologies in everyday science practices" (p. 529) that push on privileged forms of science, and
(4) exploring the intersection of science with social movements toward social transformation and justice.

Eric J Pyle, NSTA President: Next Gen Navigator
Wendy Binder, NSTA: Thanks Eric!

Jody Binz: 14 Fridays...
LeeAnn Mikkelson (she/her): 14 Fridays: Preparing Educators, great book title...

Deb L. Morrison - UW: ACESSE PD Modules

Aneesha Badrinarayan: Task Annotation Project in Science (TAPS)

Lizette Burks: UARK Program
Lizette Burks: University of Michigan Pre-Service Science Resources

Eric J Pyle, NSTA President: NSTA Conferences & Events

Jess Harris: "We are what we repeatedly do. Excellence, then, is not an act, but a habit."
— Will Durant

Deb L. Morrison - UW: Thanks Thomas for the naming of the "mundane" as a location of equity and justice in practice and implementation.
Suzy Loper: "Mundane, everyday programmatic decisions make the vision come into existence, or not."
— well said Thomas Philip!
Kevin Anderson: Appreciate these points, Dr. Philip! I review new science license programs for the state. There is a huge range in quality of programs. Further collaboration across programs to enhance expertise would be very helpful.

Wil van der Veen: I am wondering if one of the challenges of teacher preparation programs is that they compete with their prior experiences in K-16.
Bev DeVore-Wedding (she/her): @Wil yes, I struggle teaching math methods with a 5E model discovery first and then explanation. Department chair doesn't get it; says that is for science not math...
Darcy McMahon: @Will - Yes! In MI we have tried to structure teacher prep standards to ensure that teacher candidates have experiences learning the content in ways implied by our K-12 standards (ie 3D science, etc)

Nathan Spencer: Teacher Prep programs and ISD consultants, along with others, need to collaborate much more closely so this work can be carried forward, built on...
Darcy McMahon: +1 Nathan! How do we get that working . . .??

Eric J Pyle, NSTA President: Many of these have focused on Social Justice of late: NSTA Web Seminars

Lizette Burks: https://www.tandfonline.com/doi/full/10.1080/1046560X.2019.1668218

Lauren Kaupp: I appreciate Lizette naming that there can be a (dis)connect between the state/district and the university. There can also be a (dis)connect between the goals of the state/district and the enacted practice in schools.
Nathan Spencer: +1 Lauren

Tina M Larson: Our wonderful Mary Starr in Michigan has begun promoting pre-service teacher memberships in professional organizations both state and national. As always, hats off to Mary! =:)
Darcy McMahon: +1 Tina!

Lauren Kaupp: e.g. students have an elementary science methods course and then are told during their student teaching that their placement school "doesn't teach science"…
Darcy McMahon: So sad, but true, Lauren😞

Wanda: @Lauren I would say to teachers in placements that don't teach science is be subversive BUT have evidence to support what you're doing
Lauren Kaupp: @Wanda, absolutely, I think our teacher prep faculty provide that type of guidance! It's just a tricky dance and it can send mixed messages to teacher candidates.

Amy Himes: more about PLCs please!

Deb L. Morrison - UW: Love these examples of design based research to engage in staying with the trouble of finding solutions while seeking to server our youth, families, communities, and educators.

Chad - Einstein Project: Thanks for your comments, Lizette! Great to see you again!
Lizette Burks: Thank you, Chad! Good to see you too.

Patty Brown: How is it that there are adopted standards in each state and yet Districts have no apparent qualms about just ignoring the need for time teach in accordance? Same in my state, too.

Deb L. Morrison - UW: 💚 from UW to Todd.

Maya Garcia: I wonder how NARST might also support those conversations Todd

LeeAnn Mikkelson (she/her): coherence, not sameness

McCarthy, Michelle: We work with Science Education Professors to share out our Science Foundation courses developed by teacher leaders that are available free on the Office of Public Instructions Teacher Learning Hub. It is very successful. https://learninghub.mrooms.net/ and it offers consistency between the state and the universities for teacher prep

Tina M Larson: Remember Tiffany's testimonial yesterday about how meeting inspired and enthusiastic Sci educator/s changed her life - one-on-one personal encounters can be so priceless! Perhaps such encounters could be more intentionally engaged…. Such a thing profoundly changed my professional direction for the best, too! =:)

Todd Campbell: Here's some of the work we've done with mentor teacher groups: Some resources from our work:
STEM Teaching Tools: (1) http://stemteachingtools.org/brief/49 (2) http://stemteachingtools.org/brief/50 (3) http://stemteachingtools.org/brief/52
Research: (1) https://www.tandfonline.com/doi/full/10.1080/1046560X.2018.1547033 (2) https://onlinelibrary.wiley.com/doi/10.1002/tea.21688

Deb L. Morrison - UW: Reciprocity!!! And working in community and in relation!!

Philip L Bell: Todd tweets as he reads, including this piece about "pluriverse" he just referenced. Following Todd on Twitter provides many insights as he shares his learning. Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds

Matt Krehbiel: Yes!
James Emmerling: +1 Thomas "co-learners"

Kristoffer Carroll: Thomas' comment is very true. Developing HigherEd and pK-12 partnerships is dependent on a mutually beneficial model, not a transactional one. The PRP work from Bill P. et al has really helped us engage in this work.
Tina M Larson: @ Thomas Philip: Instead of dissing misalignments, make opportunity for building thought - nice! =:)

Darcy McMahon: This idea of not just mutually beneficial but mutually transformational is resonating with me!
James Emmerling: +1 Darcy

Kevin Anderson: Great point, Melissa! I'm sure most mentor teachers in that position want to do better, but feel stymied in doing so. Someone new to problem solve with can change their perspectives.
Kirsten Daehler (she/her): Really appreciate your approach, Melissa. Thanks for sharing how to coach people away from the path of judging and into communicating about working together.

Ted Willard: One thing that has been running around in my head a lot in the last year is the balance between our goals for education and the resources we have to address those goals. We find ourselves frequently advocating for resources (or complaining about the lack of them) but I am also thinking that we may as a community do some thinking about what are reasonable goals given the available resources. Articulating what is reasonable might motivate making serious choices in science education.
Tracey Ramirez: +1 Ted
Christine Salloom: Ted, I appreciate your realism
Ted Willard: @Christine One thing I find very frustrating is that there is no connection in decisions about the expectations of the science education system and the resources provided to the science education system.

Kevin Gaylor: As we think about equity, how are we or how do we begin to address working with special populations, ie. inclusion, SPED.

Lizette Burks: If you do not already know your State Science Supervisor in your state, this map might help you connect to support collective coherence in your state! http://cosss.org/members
Kevin Anderson: +1 Lizette!

Heidi Schweingruber: These are great examples of programs. I'm wondering if these approaches reflect the state of the field across the many, many preservice programs across the country. There are many kinds of institutions that prepare teachers. I suspect that there is huge variation in the quality of that prep.
Stacey van der Veen: @Heidi, I have the same question
Lauren Kaupp: +1 Heidi – I think there is variation within programs as well as among programs
Maya Garcia: +1 Heidi
Tom Peters: @Heidi We have over 30 teacher prep programs in SC…and a few non-traditional paths to certification as well.
Stacey van der Veen: @Heidi, We see HUGE variation in the level of facility with (or knowledge of) the NGSS
Heidi Schweingruber: @Tom -- exactly. And we know that teachers tend to attend programs in their own communities
Ted Willard: @Stacey Variation among whom? student teachers? classroom teachers? or science teaching faculty?

Tom Peters: @Heidi and they tend to teach in their own communities too…so whatever the local standard for science already is is what gets maintained.
Danny Edelson (he) BSCS: To @Heidi's question…teacher prep is as decentralized as our educational system gets.
Lauren Kaupp: @Stacey – knowledge/facility with, but also value of standards, desire to use, etc.

Darcy McMahon: +1 Todd - appreciate the shift to showing candidates what it looks like before sending out to enact in classrooms.

Heidi Schweingruber: How to spread these good ideas? How do we get greater traction with a wide range of programs to ensure pre-service teachers are learning about the Framework and NGSS.
Heidi Schweingruber: To me that's one of the central implementation questions.
Selene Willis: @ Heidi, don't forget us In-service people too. We want to learn and implement in real time.
Heidi Schweingruber: @Selene -- in-service is the next panel :-)

Amanda Collamore: I think one of the things I find most frustrating, especially living the in this incredible electronic age, and a reliable, high-quality, centralized location to find and go through resources that help support PST and in-service teachers.
Cary Sneider: Re: Link to Highlights from CA Early Implementers Project mentions by Helen Quinn: https://www.wested.org/resources/ngss-early-implementers-initiative-final-evaluation/
Eric J Pyle, NSTA President: @cary, @amanda - Professional Learning Resources: https://www.nsta.org/professional-learning
NSTA Resources (By Topic): https://www.nsta.org/topics

Lizette Burks: OER Teacher Pre-service Science Resources: https://library.teachingworks.org/curriculum-resources/

Gudiel Crosthwaite, he/him/el: That's great for student teachers to be paid-it's a step in the right direction

Bev DeVore-Wedding (she/her): Here in rural Colorado our undergrads have the opportunity to be paid as teachers of record...we have five right now instead of student teaching they are teachers of record.

Philip L Bell: Love that long game policy-to-practice work you are describing, Melissa!

Matt Krehbiel: Tying back to yesterday, this is work that takes decades. We may not be able to do all we want to do in teacher prep until a generation of students who have experienced more of the science learning that we are trying to make happen to grow up to be teachers and professors. This doesn't excuse us from pushing for change now, but I think means there is hope for the future.
Philip L Bell: +1 Matt Important to understand the timescale of transformation—as long as it isn't used as a detour for seeking justice as well as possible.
Patty Brown: @Matt Yes…as evidenced the past couple of years in particular, US has lost a lot of ground in adult understanding of how science actually works, its strengths and limitations. I have met elementary teachers who say (about all kinds of content and skills), "I didn't really need to know any of that so my students don't either." Never mind that the world has changed radically since we were in school and will continue to change. We need all hands on deck to solve problems and to assess validity of science claims.

Joseph Bellina: Patty how do you respond to the teacher who says they don't need to know and neither do their students ?
Patty Brown: @Joseph, I try to convince her that every person who has contributed to problem-solving and innovation was the age of her kids at one time. If that child was not given space, time, and materials, and encouraged as he/she/they grew up, their contributions would likely have been pre-empted. Some teachers are just too rigid and convince themselves that they are the Perfect Teacher. Others don't want the conversation or their classroom to be "messy." Some teachers grew up only being rewarded for being "right," people-pleasers, and being obedient. And that is what they value in their students. If we can convince teachers that scientists are question-askers as well as question-answerers. If we don't listen to children, we can't celebrate their contributions and explorations.
Matt Krehbiel: @Patty and @Joseph—and they were right. They didn't need to memorize the periodic table, the equation for photosynthesis, or the steps in the Krebs cycle. Their world was not changed by this memorization and regurgitation, but they have a chance to change their students worlds in ways they never experienced (and maybe change their own world in the process)
Lauren Kaupp: +++++++ Matt!
Joseph Bellina: patty thanks your response is on my desktop
Matt Krehbiel: @Patty—I would add that these teachers have loads of evidence that they are successful from their classrooms every day (they may not be attending to the same things that you are, but they are observing and collecting information to inform their perspective). They are following a model that they experienced for 16+ years in their own schooling—and they were able to at least navigate that system and likely became experts in navigating it. Since they started as teachers, they have likely heard from other teachers, students, parents, and administrators that what they are doing is great. It shouldn't be surprising that they are resistant to changing practice. They are doing things that make sense to them.
Wil van der Veen: Exactly Matt!
Joseph Bellina: Matt I think of this as changing teachers minds about teaching is like changing students minds about how the world works.
Wil van der Veen: @Jospeh: Yes, equally challenging
Ted Willard: @Matt Agreed. Which is why one of the first thing that is needed is to give teachers are need to implement change, what Trish calls a "Why"
Jenn Brown-Whale: and I am sure the "why"/need @Ted is different for different audiences, so thinking about what motivates our adult learners is crucial. Framing the why in what the audience cares about
Patty Brown: @Matt. True. Sorry if I sounded harsh. I have one vivid memory of a teacher. I was assigned to model for elementary teachers how to provide engaging, meaningful activities, and this teacher sat at her desk and tuned us out except for scolding students who talked out about what they were learning, even though I was inviting that interaction. So maybe teachers need to learn that "sense-making" in science might look "disorderly" at times. Classroom management might look quite different in science lessons.

Chad - Einstein Project: As someone who is teaching science methods for the first time, I am so thankful for the AST materials and model. I am confident that they will be much more prepared for entering the modern science teaching workforce.

Elizabeth A Davis: Wow, y'all, that was fabulous -- thank you to you all for your amazing thoughtfulness about teacher education. I'm so inspired by what our preservice teachers are able to experience. Thank you.
Philip L Bell: Really amazing and provocative work and thinking. I'm grateful to learn more about your efforts & stances in the work. Thank you to the panelists & organizers!

Erika Shugart, NSTA: For stories from the classroom written by teachers describing their science standards implementation journey
Erika Shugart, NSTA: JSTE article Developing NGSS-Designed Instructional Materials with Teachers at the Table
Philip L Bell: +1 Erika — those accounts are extremely valuable in our work with inservice teachers on what the work looks like, what issues come up & how to work through them

Tina M Larson: I really enjoy and appreciate the broad cultural and geographic diversity of all the panelists both these days! This diversity seems to elevate our thinking and sensitivities, and expectations. Thank you so much. =:)

Laurie Salvail: So proud of the work happening Louisiana!
Jacob Foster: @ K Renae. I appreciate your phrasing "when things get safer" rather than the ubiquitous "when things return to normal" that I hear too often.
K. Renae Pullen: I don't want to go back to normal. It wasn't as awesome as we thought. :)
Matt Krehbiel: ^^^
Richard Bacolor: +1 K.Renae and hi my friend. Thank you for sharing your expertise here.

Jim Short: To learn more about the type of curriculum-based professional learning that Jodi and Breigh are talking about, Carnegie Corporation published this report last year, The Elements: Transforming Teaching through Curriculum-Based Professional Learning
Julie Ballance: +1 Jim. Great resource!
Darcy McMahon: @Jim - thank you so much for reminding me of that resource! I was just looking for that information!
Amy Trauth: @Jim, thanks for this. Curriculum-based PD gets at @Matt's earlier comment about teachers' classrooms practices. They do things that are sensible to them. If we want them to adopt or shift their practices, we have to provide them with models, preferably with grade-level materials salient to what they teach.

Erika Shugart, NSTA: With change initiatives you can't change people by making them feel bad about what they are doing but by inspiring them to do even better
Maya Garcia: Well said Erika
Matt Krehbiel: +1 Erika
Heidi Schweingruber: +1 Erika
Jenn Brown-Whale: Agreed @Erika
Eric J Pyle, NSTA President: +1 Erika
Ted Willard: @Erika, I think you can help them to see that what they are doing is falling short of their goals, but ONLY if you can also provide them a path to do better.
Ted Willard: Otherwise you just make them feel lost

Lizette Burks (she/her): +1 Breigh In the moment sharing can be critical to help move forward!
Eric J Pyle, NSTA President: @Breigh - well said! about what's next - pushing the comfort zone.

Wendy Binder, NSTA: Assessing your work and life thought your "Why" is so powerful and game changing and Trish showed me that by example!

Ashley Iveland: Another resource hub about a large-scale NGSS implementation Initiative in CA that may have good resources and tools/practices that were used during this Initiative

Bill Penuel (he/him/his): More on curriculum units designed with coherence from the students' perspective

Rachel Connolly: This is still one of the best briefs I have ever read about using Phenomena and what it should look like
Lizette Burks (she/her): +1 Rachel!

Lauren Kaupp: +1 Stacey – baby steps / toe dips can be powerful
Eric J Pyle, NSTA President: +1 Stacey - professional rejuvenation
Wanda: Trying one thing helps a lot! Wow-that worked better than I expected!
Darcy McMahon: +1 Stacey- so real
Maya Garcia: +1 Stacey, Rabiah mentioned that as well this morning!
Dua Chaker: Well said Stacy!!

Suzy Loper: Hooray for the @Explo!
Kevin Anderson: Love the Exploratorium!
Elisa Slee: The Exploratorium teacher institutes have been invaluable!
Maia Binding: The Exploratorium is where I participated in some of the best PL of my career. The work they do is inspiring (and I say that as a PL provider!).
Kirsten Daehler (she/her): @ Julie, I wanted you (and your colleagues) to know that my early years as a HS science teacher were profoundly shaped by the professional learning I participated in at the Exploratorium. Thanks for keeping the mission. ;-)
Trisha Herminghaus: ^^@Kirsten
James Emmerling: ^^Yup!
Julie Yu (she/her): 💙
Suzy Loper: @Julie, same same. Physics Teachers summer institute in 1995 saved my life as a new teacher! (And many summers after)

Matt Krehbiel: @Patty-I'm with you. Changing practice is often frustrating and even infuriating when it's not being magical.

Lauren Kaupp: Thank you Stacey for acknowledging that…it's a continuum for everyone involved in NGSS implementation
Ted Willard: Stacey's comments are further evidence that we have only reached a small percentage
McCarthy, Michelle: love that - sounds similar to lesson studies!
Darcy McMahon: Love this lesson study model, Stacey!
Eric J Pyle, NSTA President: @Stacey - maybe administrator PD should include creating a safe-space climate for teachers to try out innovations. Reducing anxiety for risk-averse teachers?
Jessica Monaghan (she/her): Using student work is so beneficial for seeing what is present in student thinking (or not!) as well as grounding the reflection in evidence. Yay Stacey!

Jess Harris: Yess Jessica - this is the heart of a true PLC.

Patty Brown: Some success with having students video record their explanation of a phenomenon and evidence supporting the explanation.

Lauren Kaupp: In addition to the Guide to Implementing (https://www.nap.edu/catalog/18802/guide-to-implementing-the-next-generation-science-standards), the Council of State Science Supervisors Science Professional Learning Standards are an excellent framework (http://cosss.org/Professional-Learning)

Wil van der Veen: I think that an additional challenge we may have is that when 10 educators/admins visit the same classroom they come away with different very ideas whether this is an NGSS-aligned classroom or not.

ellen.ebert: +1Breigh!!! Same experience in WA.

Ravit Duncan: M'Kenna OpenSciEd unit- https://www.openscied.org/instructional-materials/7-3-metabolic-reactions/
Kate McNeill: PL resources (powerpoint, agendas, classroom videos, handouts) for M'Kenna is here. 7.3 Metabolic Reactions - https://www.openscied.org/professional-learning-materials/curriculum-launch/

Amy Trauth: @Julie, THANK YOU! PL doesn't have to be a "workshop"…
K. Renae Pullen: 👏🏾
Melissa Braaten: For real, Julie!
Candyce Johnson: Yes! Professional learning also means reflection and planning for implementation.
Matt Krehbiel: 🙌

Kirsten Daehler (she/her): A marathon has two halves, the first 20 miles and the last six!
Lindsey Roy: +1 Whew Julie! Great comments!
Lizette Burks (she/her): +1 Julie! Hydrate and add calories!
Melissa Braaten: Hydrate and add calories is my new motto. Thanks, Julie.
Matt Krehbiel: Right on, Julie!
Zoe Evans, Bowdon High School: ❤️ hydrate & add calories!
Bill Penuel (he/him/his): @Melissa and @Julie: In a long run, you need to eat to keep from bonking!
Breigh Rhodes: Yes, loved that @Julie! hydrate and add calories! I'm using that

Matt Krehbiel: A wide variety of knowledge and understanding (likely with an inequitable distribution) probably won't change as long as there is a linear model of first researching and then delivering/sharing the research with practitioners. It seems like we have loads of evidence this is the case—and that it means that it takes WAAAY too long for the research to impact student learning (if it does). How can we disrupt this linear model, which is clearly not meeting our needs, and have more Research Practice Partnerships that recognize classroom educators as partners in advancing teaching and learning, rather than end users of research findings?
Wendy Binder, NSTA: @Matt amen
Amy Trauth: @Matt, does that require different tenure requirements for faculty?
Wil van der Veen: Agreed Matt. That has been my experience for 20 yrs
Jess Harris: Matt, this response exemplifies the inequity that currently exists in educational research that was brought up earlier today.

Ted Willard: I go back and forth on small steps vs. big leaps. I sometimes like to think about what it takes to make a rocket work. (Think of what went on in the early days of NASA). Even if you have 90% of the systems are working perfectly, the rocket may still blow up. In what ways is the same true for

science learning. What are the "mission critical" pieces that are truly essential to student learning. If we don't have those elements, then we still get no learning. But I don't know if we have really identified those pieces (although I think we are getting close these days).

Lauren Kaupp: Time keeps coming up as a critical factor in so many different ways.

Bill Penuel (he/him/his): +1 Renae — the stuff is important (and expensive, and needed)
Lizette Burks (she/her): ++ K. Renae....we NEED more open and free options!
Suzy Loper: Yes K. Renae: physical space is an issue!
Tracey Ramirez: Critical points, @K. Renae Pullen!
Matt Krehbiel: @K. Renae—absolutely!
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: +1 K Renae-- exactly!
Kate McNeill: +1 Renae!!
Amanda Collamore: @K. Renae - YES! Free is not free
Jim Short: +1 Renae Amen to implementation requires funding
McCarthy, Michelle: Integration with science as a base! YES
Todd Campbell: @Renae - GREAT leader and twitterer!!!
Tracey Ramirez: And administrators need PL as much as teachers!!!
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: Wow!! Renae you need to write this down and share it with the world! Well said!
Kevin Anderson: Agree, K.Renae. Administrators have their own constraints - often that includes implementing boxed curriculum which have their own time parameters for fidelity. They need support that can fit within the unique constraints and overwhelm-ness that they face too.
Amanda Collamore: @Kevin, administrators needs support from the school boards to allow for the flexibility.
Brian Reiser (he/him): +1 to K Ranae and Jody - administrators are key and need support but in principle (no pun intended) could really become allies
Lauren Kaupp: @Kevin, I think the opposite is also true – having no curriculum and trying to Frankenstein things together.

James Emmerling: Need support for teacher practice to make use of high-quality materials

Jess Harris: It took me SO MUCH TIME as a teacher to make it fit in my classroom context. I did it, but it was a lot of work.

Tracey Ramirez: To get systemic change, administrators need the PL as much as teachers
Tracey Ramirez: Uninterrupted time!!
Kip Bisignano: Elementary teachers have been beaten up with highly structured reading and math programs and no longer have autonomy to adapt instruction for the kids in front of them.
Tracey Ramirez: Don't fill that time with other meetings!

Carol O'Donnell (she/hers), Smithsonian, Washington, DC: Well designed curriculum materials / instructional materials (and differentiated professional development aligned to these materials) do allow for this flexibility. I don't think we should assume they don't.

Ted Willard: In many ways, admins need more professional learning rather than less

Patty Brown: And some administrators substitute NGSS itself for a curriculum. I actually had an administrator "write" the curriculum by cutting and pasting the NGSS standards, add a bundle of vocabulary words, then chunking them into units, one of which was "Science Practices." Made me nuts!

Jim Short: High-quality instructional materials are important, but how teachers use them is more important, which is why curriculum-based professional learning is a must for a quality implementation.

Amanda Collamore: We also need to bring school board members in so they can more fully understand what they are asking/dictating to teachers and administrators do.

Liz Wolf - Cincinnati: Sub coverage for that work to happen is crucial but subs are very hard to come by at the moment.
Meg Richard, KSDE STEM: It's not just New Jersey :(
James Emmerling: Michigan too
Brian Reiser (he/him): @Stacey it is not unique to NJ - we are struggling with this in finding time for PL in IL
Laura Saxe-O'Brien: OR, as well
Kevin Anderson: No subs in Wisconsin either. And no bus drivers.
Thrivewith SECO: teachers losing plan everyday to cover other classes
Zoe Evans, Bowdon High School: The sub shortage is huge !
Melissa Mendenhall: Subs is also a huge issue in Utah
Philip L Bell: Many teachers in Seattle just lost all of their prep periods so they can sub instead. That won't go well.
Richard Bacolor: We don't have enough classroom teachers let alone subs.
Zoe Evans, Bowdon High School: We are covering classes daily.
Liz Wolf - Cincinnati: +1 Richard....Let alone a certified high school science teacher even with signing bonuses.
Amanda Collamore: It's hard to find subs when they pay is so low compared to going to work for retail and fast food places.
Tina M Larson: @ Rich - yes, in Michigan…. @ Patty - thanks. =:)
Amy Trauth: @Rich, yes, science teacher shortages in Delaware, too. Many positions have gone unfilled.
Tracey Ramirez: And teachers are leaving the profession at an alarming rate...

Susan Allison: Would there be mechanisms to celebrate successes & model lessons/units/teachers/districts that would drive the process? My teachers don't need more "Nope-you didn't do THAT right…". :(

Wil van der Veen: I find it very worrying that so many administrators that I have met in our work are afraid to learn in public. The higher up the chain, the more afraid they tend to be.

Tina M Larson: More valuable than high quality instructional materials is high quality thinking teachers! i.e. those who understand the SEPs and CCCs, and have the skill to listed to Ss innate Science Talk, etc….who can create a souffle when there's just a couple of eggs and some butter in the fridge. =:)
Patty Brown: @Tina—I like your metaphor.
Lauren Kaupp: @Tina – high quality instructional materials are extremely important AND we also want teachers to understand the standards as well.
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: +1 Lauren

Tina M Larson: @ Lauren, yes, but if I could only have one or the other, I'd choose Tt who are willing to be vulnerable and think out the box of their traditional comfort zones. =:)
Lauren Kaupp: @Tina oh yes definitely we have seen what happens when there is a higher value on "everyone be on page 79 on Friday" than student learning

Meg Richard, KSDE STEM: I'm hoping that we will be able to use the lack of subs as an opportunity for family centered partnerships- the summer is always an issue but if we compensate teachers for their time and partner with groups who offer experiences for family.... cross our fingers

Chad - Einstein Project: I was just typing that same question! Partnerships are critical to support all educators! But we need to figure out how to plug more schools/teachers into those partnerships.

Rebecca Abbott: Shout out to some of our district instructional leader partners in Lodi, CA who are using a strategy called "scones and science" where they have school visits and chat with principals about their science implementation! Professional learning in another format.
Meg Richard, KSDE STEM: Yes Rebecca! Our state organizations are offering "think and drinks" and Sips and Science"
Heidi Schweingruber: @Rebecca, what a great idea.

Philip L Bell: 👏🏻 Thanks for that insight, Julie!

Eric J Pyle, NSTA President: There is a shortage of people who are willing to parachute into a hostile environment for $16/hour…and could pass a background check!
Amanda Collamore: @Eric, especially when Walmart is offering $16+/hour...
Patty Brown: Our district raised the pay of non-certified subs to equal certified subs. I wish a training would be provided to the non-certified. Some really consider it babysitting.
Tina M Larson: @ Eric 😆

Tom Peters: We know what all the pieces are… Putting them all together and keeping them together is an enormous challenge.
Trisha Herminghaus: ^^@Tom
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: +1 Tom - well said.
Amy Trauth: +1 Carol!

K. Renae Pullen: We also have TLs in Louisiana. I even have a elementary science task force that is (mostly) supported by the district. Yes, y'all. Elementary!

Patty Brown: It is so motivating to share both challenges and successes.

Candyce Johnson: I have to shout out the Urban Advantage Science Initiative in NYC. It's a comprehensive program that enlists 8 cultural institutions in partnership with NYC schools to provide full school support to teachers, administrators, and parent coordinators.
Candyce Johnson: partnerships are SOOOOO important to make connections between the communities and schools
Lizette Burks (she/her): Thanks @Candyce...will have to dig in more!

Michelle Phillips (she/her): Thank you for acknowledging the assets - and not only deficits - of our teachers Julie!

Matt Krehbiel: ^^^

Wanda: https://stemtlnet.org/theme/september2021-expertpanel a great resource for teacher leaders

Patty Brown: GLOBE program is supported through the university, Fish and Game, "Fresh Eyes on Ice," REAP (renewable energy non-profit), local watershed councils…

Michael Wysession: We also need to get university scientists more engaged in K-12 PL.
Candyce Johnson: ^^^^^ Yes Michael

Kirsten Daehler (she/her): Really applaud all of the efforts to support TLs. We've seen that the states and regions across the US who make this investment in science education leaders get decades of a return on investment. Great examples in NM, MI, TX and more

Candyce Johnson: I would love to see more collaborations between the university and K-12 schools for partnerships with teachers and students

McCarthy, Michelle: We've used tribal "Climate Change Plans" as exploratory resources within Prof Learning with teacher leaders.

Amanda Collamore: When I was in my practicum placements, I remember being shocked to hear that the focus of keeping the student across the grade at the same place was fueled a lot be the fact teat there were twins in separate classes, but the parents didn't understand why they had different homework. Instead of taking the time to educate the parents to help their understanding, the district just required all teachers to be "on the same page"
Bev DeVore-Wedding (she/her): @Amanda SMH
Lauren Kaupp: @Amanda :(
Candyce Johnson: That's so frustrating Amanda. :(I'm sorry.
Amanda Collamore: Thankfully, it was my second placement (the program I was in had us in classroom placements starting in our 2nd semester), so I had a better example to base my experience on.
Patty Brown: @Amanda It can be crazy making: teach every child where they are (RTI discussions), but give the same high-stakes test and teach from "the same page." What???
Amanda Collamore: @Patty, I asked a lot of questions about why the goal was "on the same page" and not "help the students grow"
Patty Brown: @Amanda Exactly.

James Emmerling: Conversations have been focused on teachers that are engaged. Why are others not engaged in PL opportunities and how do we bring them in?

Tina M Larson: I experienced that, pushed back, and won! (Wasn't sure what the outcome was gonna be ahead of time tho…). =:)

Michael Wysession: Still a great resource: https://www.nextgenscience.org/resources/ngss-all-students

Kevin Gaylor: I think one thing we should do is make sure that pre-service teachers know about the National Framework. In Mississippi, I have been pushing that work across the board. My baseline conversation as I continue to work with teachers is the Framework for K-12 science. I thought for 10

plus years and science leaders at the time never made that work a part of any training that I was a part of. I am committed to putting that information in the hands and minds of ALL science teachers. This is
Maya Garcia: +1 Kevin
Sharon Cates-ID: Yes Kevin!

Liz Wolf - Cincinnati: Principals need PD outside of ELA and Math. Yes!
Julie Ballance: +1 Liz!
Sharon Cates-ID: Yes Liz!
Heather Johnston: +1 Liz

Tina M Larson: @ K Renae - true, it doesn't seem we have a great voice with our state legislators…. =:(

Patty Brown: Teachers are told to use "evidence-based research" to guide their teaching, and yet how the evidence is derived remains somewhat vague, often carried out by a publisher or marketer.

Julie Yu (she/her): We would love to work with more scholars and practitioners to support teaches of color, particularly if you identify yourself as a teacher of color. Hit me up! jyu@explotatorium.edu

Deb L. Morrison - UW: @Melissa, So completely agree that core, coherent and sustained funding is necessary for equity and justice within science learning.
Amy Trauth: Yes, Melissa! Long terms plans are moot if teachers don't stay in the profession.
Chad - Einstein Project: +++ Melissa!
Tina M Larson: @ Melissa - astonishing! Reasons? =:)
Bill Penuel (he/him/his): + 1000 @Melissa: — How do we create better organizational conditions in schools to help sustain and resource teachers?
Ted Willard: @Melissa, can you provide context and data about that statement that the workforce turns over every 3 years? offline
Melissa Braaten: @Ted, the two big districts that I work with collect their own turnover data but I can recommend scholarship more broadly in research on teacher workforce stability/instability. I highly recommend my colleague, Allison Atteberry's, research on teacher churn.
Ted Willard: @Melissa, thank you

Joseph Bellina: but it takes more than 5 years to become an expert how to stop the turnover

Tom Peters: @Melissa…workplace turnover suggests that unless we reconsider the structure of schools, we will continue patching and re-patching science education over and over again.
James Emmerling: Good point @Tom

Liz Wolf - Cincinnati: CPS has been thinking about how we can long term plan for sub access to curriculum and assessments platforms in addition to training just because of the huge need.

Lauren Kaupp: CSSS put together a resource to support districts to use ESSER ARP funding to support Science

Amanda Collamore: When advocating for changes in my local school district, of to ensure that my child is fully supported in his learning, I am constantly using the phrase "What's your goal?" My background is mostly in mathematics, so when I'm advocating, I ask is your goal to have the students only do the work your way, or is your goal to ensure the students understand how to find the correct method that works

for them so they understand the concepts. When I obtained my Associates in ECE, the "What's your goal?" mantra was repeated over and over again and is an important part of my professional work.

Lizette Burks (she/her): https://www.nbpts.org/standards-revision/
AR STEM: ++Lizette...TY for sharing this NBPTS resource

Heidi Schweingruber: I think it's important to remember that teacher workforce trends are highly local and regional. Shortages really vary in different places.

Jess Harris: We need to serve teachers with 5+ or 10+ years experience, can't just focus on new teachers (who have the highest turnover rate)
Candyce Johnson: Yes Jess. One reason I left after 12 years was because I felt abandoned.

Jess Harris: Jody, what videos do you use?

Eric J Pyle, NSTA President: https://www.nsta.org/nsta-standards-science-teacher-preparation

Christa Haverly, she.her.hers: Can someone put a link up for 5D T&L? I was referencing this in conversation the other day, but I couldn't recall where I'd seen the idea in the first place…..

Amy Trauth: Here's BSCS Videoverse

Kate McNeill: These OpenSciEd PD videos from middle school classrooms have some nice examples too

Daniel Alcazar-Roman: Sustained professional development and support is key to help teachers stay in the profession. One model that is doing that in the SF Bay Area supports teachers for 5+ years. Trellis Education

Wil van der Veen: We are hearing a lot about the realities on the ground for teachers, administrators, schools, districts etc. Going back to Ted's comment/question earlier. What can we actually expect to accomplish given the realities? I think many of agree on the "we should .." but how about the "we can ..."?
Amanda Collamore: +++++ Wil
Ted Willard: @wil Here is the provocative question for the end of the second day... When is there so little gain in terms of what we accomplish in a particular case of science teaching and learning that we should just not bother?
Kevin Anderson: Being realistic, considering @Ted's comment, I still advocate for PD that focuses on place-based, culturally-sustaining, phenomenon-based, and inquiry-rich learning ACROSS subject areas. Principals aren't going to go to PD in all subjects. Administrators aren't going to be experts in all 23 of that content areas that have standards in Wisconsin.
Maya Garcia: That doesn't seem to be the case Ted... I think what we are hearing is that implementation is messy and we are making some great gains, but we also know more now, and we have the opportunity to reenergize implementation efforts
Ted Willard: @Maya... I don't disagree. :-)
Lauren Kaupp: @Maya, I really appreciate the idea of reenergizing efforts…also pair that with the earlier point that came up about supporting all teachers, including veteran teachers
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: I want to add to @Ted and @Maya's exchange. I have been in science education for 37 years (10 in the K-12 classroom; 15 in higher ed; and

27 at the national / global level.) I have learned so much about science education over the years and I think our field has evolved immensely. We are making a difference. We keep learning and keep improving our approaches to science education.
Lauren Kaupp: @Carol thank you for sharing that

Ken Chapman: Science is a "way of knowing." Yet, in the portions of PD discussion I could attend, I did not hear anything about including real science workers -- chemists, physicists, biologists, etc. -- and their perspectives about science practices and implementation into PD.

K. Renae Pullen: *Mutual* is so important and who is the expert is so important.

Lizette Burks (she/her): ++Thomas humility!

Liz Wolf - Cincinnati: The School Board and District here in CPS has adopted an anti-racism policy. We did get push back but move forward anyway because it's what best for our students.
Amy Trauth: @Liz, I grew up in Cincy. Based on my experiences growing up there, I can only imagine the push back you got.

Suzy Loper: +1 Breigh: simplifying the vision so it is accessible to admins even without deep content expertise. All Standards, All Administrators!

Joseph Bellina: it is help to distinguish private science that mostly only scientist experience, public science what scientists journalists etc say about science and traditional school science that is an encyclopedia of public science. how do we guide students to do their own private science ?

K. Renae Pullen: Lesson Plans: Can we be like Elsa and let go of traditional learning objectives in science? We can change it up.
Lauren Kaupp: @K. Renae – why have I also cited Elsa in reference to letting go of favorite/old lessons?
K. Renae Pullen: @Lauren Because you're amazing!
Julie Yu (she/her): @ K Renae, I think we need to think deeply about what we can subtract instead of continuing to add
Lizette Burks (she/her): @K.Renae @Lauren 😂

Brian Reiser (he/him): Great point @Breigh. I agree it's all about the vision. And when principals especially K-5 have opportunity and time to dig into the framework vision, they often see it as synergistic with their other efforts in their school that may be getting more attention.

Jenn Brown-Whale: I like that @Stacey - connect teacher personal visions to SciEd vision - facilitating the connection of those dots WITH educators
Joseph Bellina: yes yes yes stacey

K. Renae Pullen: @Dr. Yu. I absolutely agree.
Lin Andrews: +Julie
K. Renae Pullen: Especially now. My colleagues are struggling.
K. Renae Pullen: Shoot. I'm struggling. :)
Julie Yu (she/her): If we keep trying to cram in more knowing that there is not enough time, our theory of action is based on hope. What can we let go of?
Tracey Ramirez: +Julie!

Maya Garcia: When we struggle Renae.. it is so important for us to be in community
Kevin Anderson: ++ Maya
Tina M Larson: @ K Renae - it doesn't sound like you're struggling! Maybe listen to your inner voice to be reinvigorated the way you've invigorated many attendees during this Seminar! =:)

Amanda Collamore: I think in the PD and PST experiences, opportunities for individuals to learn how to also educate the parents is important. Parents don't understand why the changes are being made. Parents fight back and kids hear parents say "I don't understand why it can't be how I was taught when I was in school?" and may not take value from the lessons they are taught. Parents need to be educated in the changes almost as much as teachers do.

Bev DeVore-Wedding (she/her): +100 @Kevin for place-based, culturally-sustaining, ...learning!!!!

Amanda Collamore: Its all part of the "it takes a community" mindset

James Emmerling: MMSLN is hosting a follow up chat October 19, 2021, 12:00 pm - 1:30 pm and October 26, 2021, 12:00 pm - 1:30 pm. Join the discussion at https://mimathandscience.org/courses-registration/

Lizette Burks (she/her): ++Melissa! Conscious consumers early on!

Breigh Rhodes: In Louisiana, one way we are working on this is through a collaborative with methods course instructors. Through shared PD that leverages HQIM and ongoing PL, we co-design an ideal course syllabus

Wil van der Veen: @Ted Education is to important for us to stop trying but maybe we need to focus our energies on what can be done given any local/regional/national realities. There are lots of wonderful should of wants, but maybe the focus need to shift to can, which may be different locally.
Ted Willard: A repeat of a message I gave yesterday. I believe we have made more progress in science education in the last 8 years than we did in the previous 16 years.

Amy Trauth: 100% Jody!
Amy Trauth: Why oh why do we ask PSTs to write units from scratch?!
Kevin Anderson: Agreed, Jody!
Amy Trauth: It's totally unreasonable. Wouldn't they be better served by learning how to be critical consumers?

Heidi Schweingruber: A reminder that the third day of the summit is on Dec. 8th!! This is NOT the end.

Matt Krehbiel: Something I was again reminded of in the past two days. When talking about challenges, it is HARD to keep from slipping into a deficit mindset and coming up with solutions that "fix" other people.
Ted Willard: +1 Matt
Elizabeth A Davis: +1 Matt
Gary Myers: +1 Matt
Richard Bacolor: +1 Matt fix spaces all day
Stacey van der Veen: +1 Matt

Jamie Rumage (she/her): I appreciate all of the voices brought together, and moving forward having a student panel, authentic student voice would be incredibly powerful also.

Philip L Bell: A Reflection: I have been wondering about the status of Framework implementation work with the 574 Tribal Nations in the U.S. context. Has that vitalwork been opening up over the past decade in responsible ways? We can't get to educational justice without Indigenous justice. My thoughts here are grounded in the educational sovereignty rights of Tribal Nations that relate to the established treaty rights they hold with the U.S. They are sovereign nations that should be engaged through a government-to-government framework.

Amanda Collamore: I'd love to have more opportunities like this. Maybe a session each quarter to allow for more collaboration across the country.
Maya Garcia: Great suggestion Amanda!
Jess Harris: Amanda we can also connect on Twitter using #scistandards #PLN
Heidi Schweingruber: @Amanda -- we at BOSE have definitely been thinking about that in reflecting on the meeting. Stay tuned!
Trisha Herminghaus: ^^Amanda!
Amanda Collamore: @Jess, I will have to create a Twitter account. I'm a Facebook user... LOL!
Ted Willard: #StandardsAreMyLife
Maya Garcia: We will also synthesize at an in person meeting in April
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: Big takeaway: Science education is like a garden: we clear out the weeds (what does not work); we plant new seeds (new ways of teaching and learning based on research); and, we nurture growth for students and teachers through curriculum + aligned professional development
Philip L Bell: #AllResourcesEachStudent - leverage the diverse sense-making resources of each learner
Brian Reiser (he/him): @Ravit - agree totally. I want to go back thru the ideas of the last two days and see examples of all these good ideas in action.
Jess Harris: Sincerely grateful for this open access science panel - it's been very inspiring! Looking forward to continued discussion!
Amanda Collamore: It is amazing that, in such a fast paced world, making changes and learning about the changes can be so slow. I am so happy I was able to take part in this and learn about all of the wonderful things these amazing professionals have done.
Tracey Ramirez: +Jess
Kate McNeill: @Ravit @Brian. Yes more (and more diverse) examples in action!
Jody Binz: I resonate with the consequential practices that Thomas Philip talked about and would love to link that with an emphasis on consequential PL programs.
Maya Garcia: +1 Jody!
Eric J Pyle, NSTA President: @Heidi - can specialized sessions be provided to those organizations?
Amanda Collamore: We need to get "buy-in"
Chad - Einstein Project: Thank you all for the opportunity to participate and listen in on the tremendous efforts happening all of over the country. I look forward to further opportunities and ways to engage!
Carol O'Donnell (she/hers), Smithsonian, Washington, DC: The Smithsonian Science Education Center looks forward to contributing to this work, Heidi, as one of those national (global) organizations. We are committed to this work.
Heidi Schweingruber: @Eric-- yes. We have a year of engagement with the Call to Action. The intent is to cultivate support across a broad array of stakeholders.

Resources Shared

Reports by the National Academies of Sciences, Engineering, and Medicine

- America's Lab Report: Investigations in High School Science (2006)
- Taking Science to School: Learning and Teaching Science in Grades K-8 (2007)
- Learning Science in Informal Environments: People, Places, and Pursuits (2009)
- Surrounded by Science: Learning Science in Informal Environments (2010)
- Guide to Implementing the Next Generation Science Standards (2015)
- How People Learn II (2018)
- English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives (2018)
- Science and Engineering for Grades 6-12: Investigation and Design at the Center (2019)
- Teaching K-12 Science and Engineering During a Crisis (2020)
- Call to Action for Science Education: Building Opportunity for the Future (2021)
- Science and Engineering in Preschool Through Elementary Grades: The Brilliance of Children and the Strengths of Children (2021) #BrillianceAndStrengths

Resources Shared by the Community

Day 1

Teaching Tools for Science, Technology, Engineering and Math (STEM) Education

http://www.cosss.org/acesse
https://sites.google.com/view/acesseproject/home

https://twitter.com/search?q=%23NGSSchat&src=typed_query (Twitter #NGSSchat)

https://www.nextgenscience.org/video-hub/video-hub
http://www.teachingscienceisphenomenal.org/store/p10/EngagewithGRC.html

NSTA:

- Investigating Environmental Racism in the High School Biology Classroom
- Justice-Centered Science Pedagogy: Leaning Beyond the Boundaries of Equity and Culturally Responsive Practices
- Facilitating Emancipatory and Justice-Centered Environmental and Climate Learning

STEM Teaching Tools (main site): contact Phil Bell

- Focusing Science and Engineering Learning on Justice-Centered Phenomena across PK-12
- How can you advance equity and justice through science teaching?
- PD Playlist: Promoting Student Science Talk in the Classroom
- PD: Professional Development Session Resources

ACESSE-Project-National-Survey Equity Implementation Infographic

Exploring the role of coherence in science teachers' sensemaking of science-specific formative assessment in professional development

https://www.openscied.org/
http://learninginplaces.org/
Attributes of Quality Science Standards (Tiffany)

What about a dimension of engagement, equity, and diversity practices? A critique of the next generation science standards → (Researchgate download version)

Just Schools: Building Equitable Collaborations with Families and Communities

https://www.colorado.edu/program/inquiryhub/about/ihub-team
https://ngs.wested.org/
https://ngs.wested.org/nextgenscience-ngss-design-badge-and-high-quality-science-units/

Rethinking Scale: Moving Beyond Numbers to Deep and Lasting Change

The Art of Gathering: HOW WE MEET AND WHY IT MATTERS

Connected-science-learning Climate Change

Equity Across State Systems: Possibilities and Tensions in Understanding Scale

Creating a system of professional learning that meets teachers' needs

https://logancenter.isbscience.org/our-work/

Infrastructuring Teacher Learning about Equitable Science Instruction

Artful infrastructuring in two cases of community PD

Making the case for the importance of building partnerships, see Chapter 7 of
Guide to Implementing the Next Generation Science Standards

Dr. Stefanie Marshall Google Scholar Listing

Marshall et al 2021 The role of collective sensemaking and science curriculum development within a research–practice partnership

Humanizing school communities: Culturally responsive leadership in the shaping of curriculum and instruction

THE STATE OF STATE SCIENCE EDUCATION POLICY: ACHIEVE'S 2018 SCIENCE POLICY SURVEY

High School Graduation Requirements (50 state comparison)

State-by-State Graduation Requirements (Class of 2015)

https://www.climetime.org/cbo-grantees/
https://sites.google.com/alaska.edu/arcticandearthsigns/

How you can be good at math, and other surprising facts about learning | Jo Boaler | TEDxStanford

NSSME Project (2018 Report) -- see also elementary science report and other breakdowns

Science Professional Learning Standards (CSSS)

Inquiry Hub: Research Based Curricula Supporting Next Generation Science Standards

Design Based Implementation Research

Research Practice Partnership Toolkit

2021 EDUCAUSE Horizon Report: Teaching and Learning

Day 2

Panel: Centering Student Experience in Science
From Ravit Duncan's intro slides:

- Beyond Equity as Inclusion: A Framework of "Rightful Presence" for Guiding Justice-Oriented Studies in Teaching and Learning (pdf link)
- Designing for Social Justice in Science Teaching and Learning: Working Toward Rightful Presence (NSTA BLog)
- Rethinking High-Leverage Practices in Justice-Oriented Ways (pdf link)

Sycamore High School's Synnovation Lab (interdisciplinary format for HS)

The power of physical 'stuff' in our digital world | Carol O'Donnell | TEDxFoggyBottom (video)

Reframing the Discussion on "Learning Loss" (Wisconsin Science and STEM Education blog)

How can we confront and dismantle systemic racism through science learning? (STEM Teaching tool)

How to launch STEM investigations that build on student and community interests and expertise (STEM Teaching Tool)

Re-Making STEM

Using Science to Bolster Literacy Skills in Elementary Education
https://753a0706.flowpaper.com/CCSSOUsingSciencetoBolsterLiteracyFINAL/#page=1

https://ssec.si.edu/ (no specific resource featured)
Sustainability Mindsets Icons

https://www.openscied.org/covid-19-health-equity/ (OpenSciEd Units)

https://www.edweek.org/teaching-learning/the-art-of-making-science-accessible-and-relevant-to-all-students/2020/03

http://learninginplaces.org/

Teaching Empathy Through Design Thinking

STEM Teaching Tools PD

- Making Science Instruction Compelling for All Students: Using Cultural Formative Assessment to Build on Learner Interest and Experience
- Learning to See the Resources Students Bring to Sense-Making

Nā Hopena Aʻo (HĀ) Framework from Hawaiʻi

Instructional Materials Designed for A Framework for K-12 Science Education and the Next Generation Science Standards: An Introduction to the Special Issue from the Journal of Science Teacher Education

Learning Science at Home (Smithsonian Magazine)

Identity Mapping (pdf)

Everyday science learning and equity: Mapping the contested terrain (Philip & Azevedo)

NSTA's NEXT GEN NAVIGATOR Archives and Conferences and Events
NSTA Web Seminars

New Connected Science Learning Issue on climate justice - https://www.nsta.org/connected-science-learning/connected-science-learning-september-october-2021

PD: Professional Development Session Resources (STEM Teaching Tools as part of ACESSE Project collaborations)

Task Annotation Project in Science

Rehearsals from Teacher Education by Design - https://tedd.org/leading-rehearsals

Infrastructuring Teacher Learning about Equitable Science Instruction (Journal of Science Teacher Education)

How can mentor teachers and university educators support preservice science teachers?
How Can Preservice Teachers Orient to Students' Ideas and Sensemaking practices?
Supporting Preservice Teachers with Task-Based Instruction
Negotiating Coherent Science Teacher Professional Learning Experiences Across a University and Partner School Settings

Re-designing infrastructure as a strategy for crafting coherence across three networks focused on the implementation of the next generation science standards

Designs for the Pluriverse

CSSS List of Members By State

What Education Leaders Can Learn About Next Generation

Teacher Learning Hub (Montana Office of Public Instruction)

Commentary: Developing NGSS-Designed Instructional Materials with Teachers "At the Table" (Journal of Science Teacher Education)

The Elements: Transforming Teaching through Curriculum-Based Professional Learning (Report from Carnegie Corporation)

Sensemaking Tool (NSTA)

https://k12alliance.org/ca-ngss.php (K-12 Alliance, CA K-8 Early Implementers Initiative learning and resources)

Storyline Units: An Instructional Model to Support Coherence from the Students' Perspective (Journal of Science Teacher Education)

Using Phenomena in NGSS-Designed Lessons and Units

How do things inside our bodies work together to make us feel the way we do? (OpenSciEd unit)

The laser-model (Smithsonian Science Education Center)
Urban Advantage NYC

GLOBE Program

What about a dimension of engagement, equity, and diversity practices? A critique of the next generation science standards (JRST)

National Board Standards Revision

How Teacher Churn Affects Students and Learning - Allison Atteberry, Ed Talks 2018

NSTA Standards for Science Teacher Preparation

BSCS Science Learning Videoverse

- For free access to the Videoverse, use the code FREEACCESS when you register at https://bscs.org/resources/educator-resource-center/bscs-science-learning-videoverse/

OpenSciEd YouTube Account

Trellis education our-model

Equitable Sensemaking PD - 2.1 Scientist Circle (YouTube video)

Reading Recovery as an epistemic community: A journal of education for students at risk

CINCINNATI PUBLIC SCHOOLS (CPS) anti-racism policy

NEW STEM Tool: How to define meaningful daily learning objectives for science investigations

NextGen Time

Indigenous Steam
Indigenous Ways of Knowing and Science Teaching (Pinterest Board)
NCAI Becoming Visible Report
Reclaiming Native Truth Research Findings
Teaching STEM In Ways that Respect and Build Upon Indigenous Peoples' Rights
Implementing Meaningful STEM Education with Indigenous Students & Families