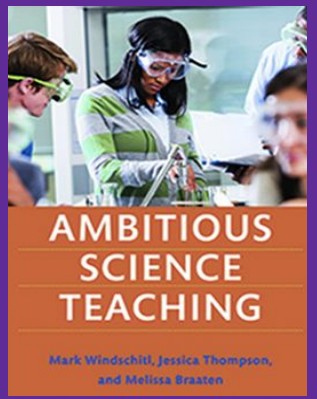
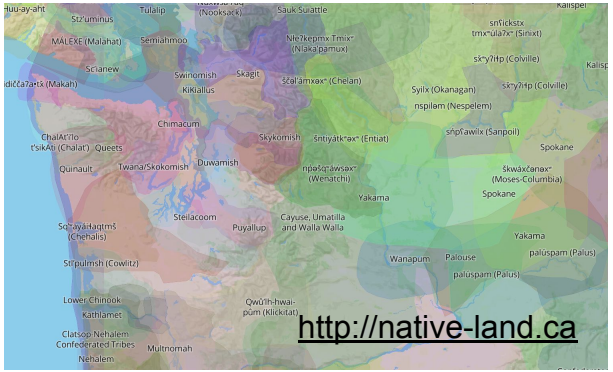
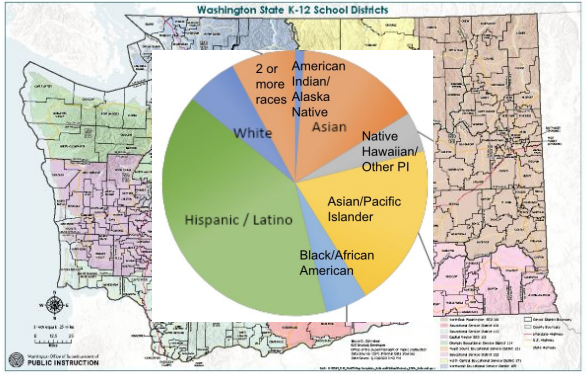
Supporting Educational Justice in the Early Years through Scientific Modeling

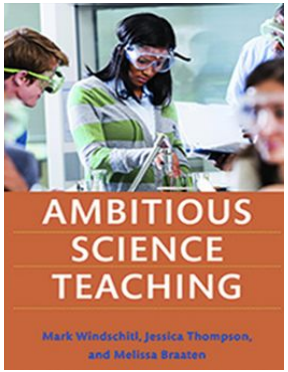
Jessica Thompson, Ph. D.
University of Washington



Context & Background



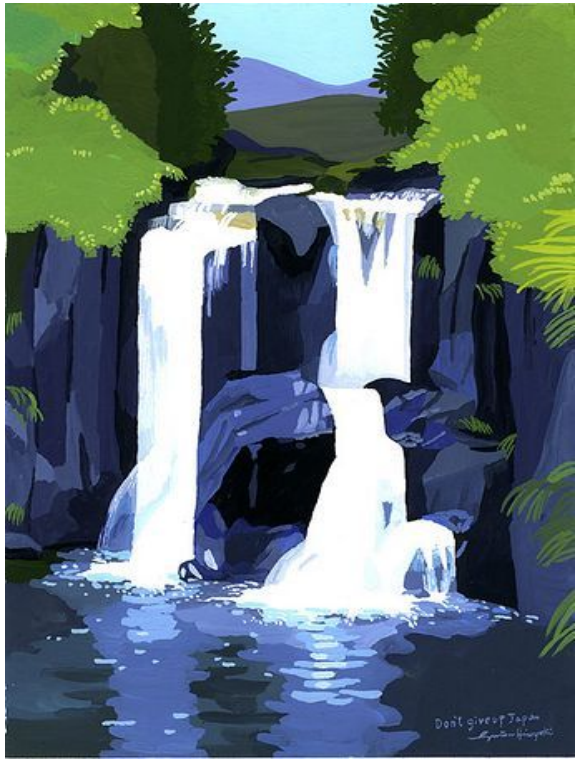




https://ambitiousscienceteaching.org/

Pause, Reflect, Share…

1) What does justice in science teaching mean to you?
2) Why must we focus on justice in science education?
3) What happens if we don't?



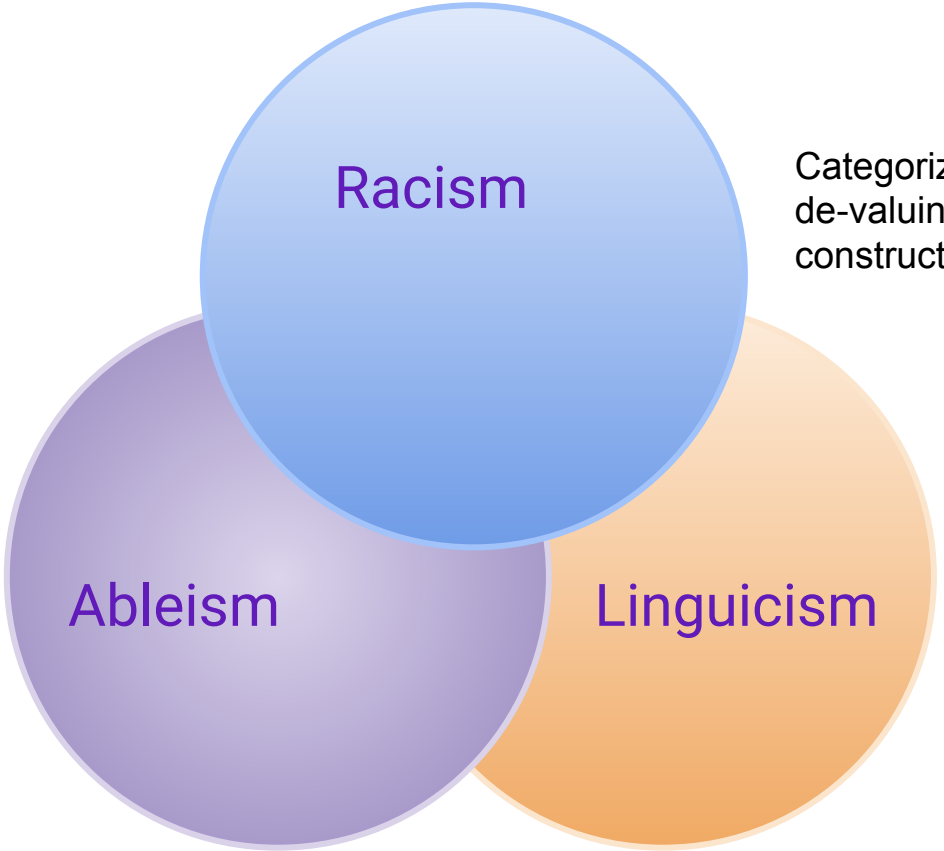
Today...

What does justice-centered modeling look like in elementary classrooms?

What shifts are needed to support teacher learning?

How can we learn from and with teachers and students?


caring
rightfully
belonging
sharing
disparities
building
challenging
agents
learning
embracing
shifting
reclaiming
sociopolitical
critically
addressing
communities
humanity
everyday knowledge
historicity
transformation
authority
participation
speculative worldmaking
prioritizing
linguicism
ecological
developing
place-based
worlds
community
non-academic
agency
recognizing
analysis
designing
cultures
needs
hope
justice
shift
justice-centered
other's
care
narratives
science
matter
culture
consciousness
ableism
change
students
supporting
power
ontological shift
relationality
futures
languages
multiplicity
historical
restorative justice
practices
making
racism
broadening
nature-culture
relations
families
critically addressing whiteness
welcoming community
joy
social
critical
adressing
leverage
co-designing
cultural
sensemaking



Categorizing, ranking, and de-valuing people based on social constructions of race

Categorizing, ranking, and de-valuing people's bodies, minds, and behaviors

Categorizing, ranking, and de-valuing people's languages or linguistic practices

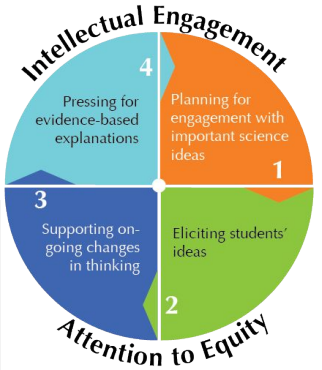
4 Principles for Educational Justice

Principle 1. Recognizing our own and other's worlds and developing critical consciousness

Principle 2. Learning and prioritizing students' communities and cultures

Principle 3. Designing for each student's full participation in the culture of science

Principle 4. Challenging the culture of science through social and restorative justice



2 & 3 Dominant view: Access, inclusion achievement

1 & 4 Critical view: Identity, power, political

C2AST (Critical and Cultural Approaches to Ambitious Science Teaching)
From Responsive Teaching Toward Developing Culturally and Linguistically Sustaining Science Teaching Practices

Co-defining Justice with Teachers

Critical view: Identity, power, political

Nature-Culture Relations & Ecological Caring

Culture, Families & Communities as Rightfully Belonging

Broadening Languages of Science

Power, historicity & futures matter

Tensions in Teacher Learning

Individual and cognitive perspectives	⟷	Social, cultural, networks & social movement perspectives
Defining equity as inclusion and access	⟷	Critical perspective on equity considering identities, power and politics & rightful presence (Gutiérrez, Philips, Calabrese Barton & Tan)
Race-neutral Teaching Practice	⟷	Race-conscious Teaching Practice (Shaw, Philips)
Settler-colonial Science and Instruction and Curriculum	⟷	Science Instruction and Learning for Liberation & Transformation (Bang, Warren & Rosebery)
English-only Instruction for status quo	⟷	Bilingual and Multilingual Instruction for justice (Flores & Rosa)

Why focus on modeling? Revising ideas

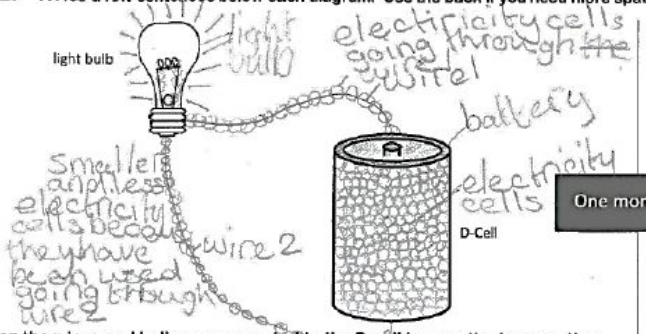
Modeling: Electrical Circuit Unit (grade 4)

Name: _____ Date: 1-4-13 Teacher: [illegible]

Why does the light bulb light up? (Or not?) – My Model

Directions:

1. **Draw** what you think is happening *inside* the D-Cell, the wire, and the light bulb in both situations ***even though you can't see inside***.
2. **Write** a few sentences below each diagram. Use the back if you need more space to show your thinking.



When the wires and bulb are connected to the D-cell in a particular way, the light bulb lights up. Draw the wires in the diagram to make the bulb light up.

Add to the diagram. Write and draw: What makes the light bulb light up? Why do you think the bulb gives off light?

I think the electricity cells go through wire 1 and light up the bulb then the electricity cells go back through wire 2 this time they are smaller and there are less of them this keeps happening and smaller and less keep coming through

One month later

now we have fewer cells because the others have die intergrated

Draw in the wires you drew before. In this diagram, the bulb is left connected to the D-cell for one whole month. Now, the light bulb is no longer giving off light.

Why do you think this could be? What do you think would cause the light to go out?

the electricity cells keep going through smaller and less of them through the wire 2 until hardly any are left and the electricity cells are not strong enough to light up the bulb.

Science has urgent & consequential real-world connections

April protest in Brasilia (Sergio Lima/AFP/Getty)

What Indigenous Rights Have to Do With Fighting Climate Change

In Brazil, a struggle over the future of the Amazon is taking place. The struggle will have global impact.

Before building another telescope, learn from Hawaiian culture

Amid continued protests over the construction of the Thirty Metre Telescope on Mauna Kea, **Haunani Kane** suggests scientists can learn from Hawaiian culture

COMMENT | COMMENT 30 July 2019

By Haunani Kane

Southern California to see steep hike in fire danger due to warming, study finds

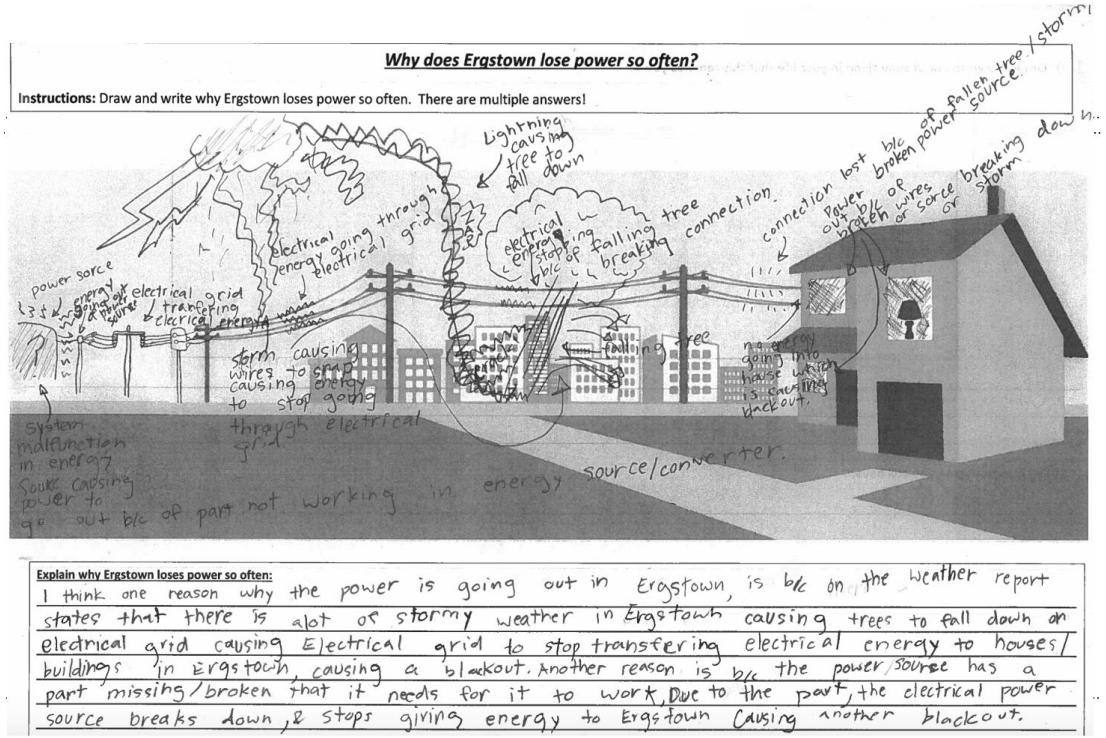
Study projects large increase in number of high-risk fire days and a longer fire season

By Diana Leonard

February 17, 2022 at 12:17 p.m. EST

Phenomena that matter & Student Ideas

Different Hypotheses
Too much power/electricity is being used
Thunderstorms, lightning
Lights on all day
Something wrong with power lines
No backup generator
Trees on power lines
Human impacts- people, pilots, drive-by shootings



Student connections

Experienced a black out

- I got a little scared
- Power went out while I was reading stories
- I crashed into the wall when the power went out
- Dad made a fire, mom couldn't cook so we ate chips

Other experiences

- Light in my bathroom flickers
- Rain and lightning on my house, useless too much of the house's energy so that it runs out of power
- Thunder and lightning yesterday
- Drive-by shooting and downed power lines
- "In the Philippines there is a lot of black outs because the sun keeps affecting the electricity because it's hot there every day with 125 degrees"

Nature-Culture Relations & Ecological Caring

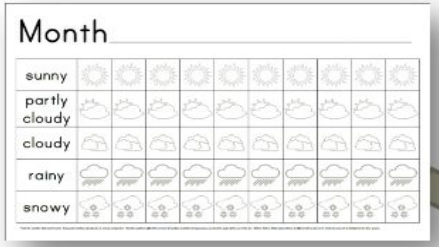
Culture, Families & Communities as Rightfully Belonging

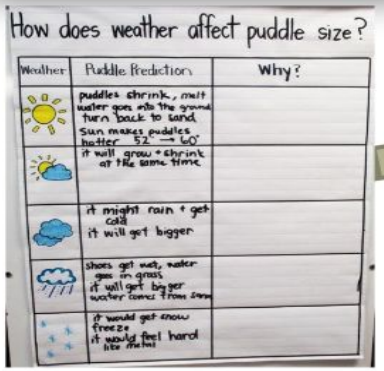
Broadening Languages of Science

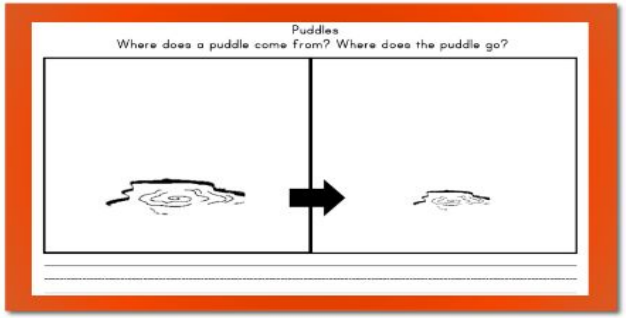
Power, historicity & futures matter

Modeling: Kindergarten weather unit

Dominant view: Access, inclusion & achievement

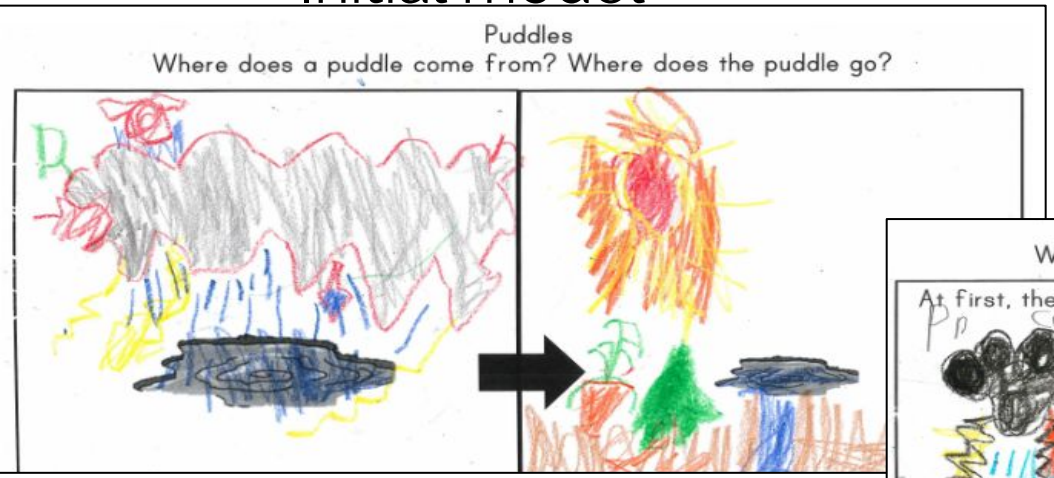




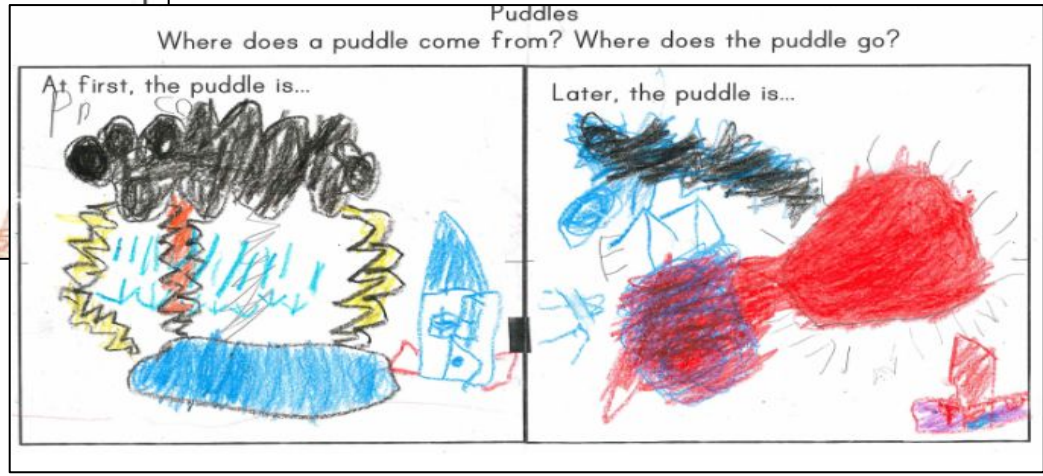


Modeling: Kindergarten weather unit

Initial model



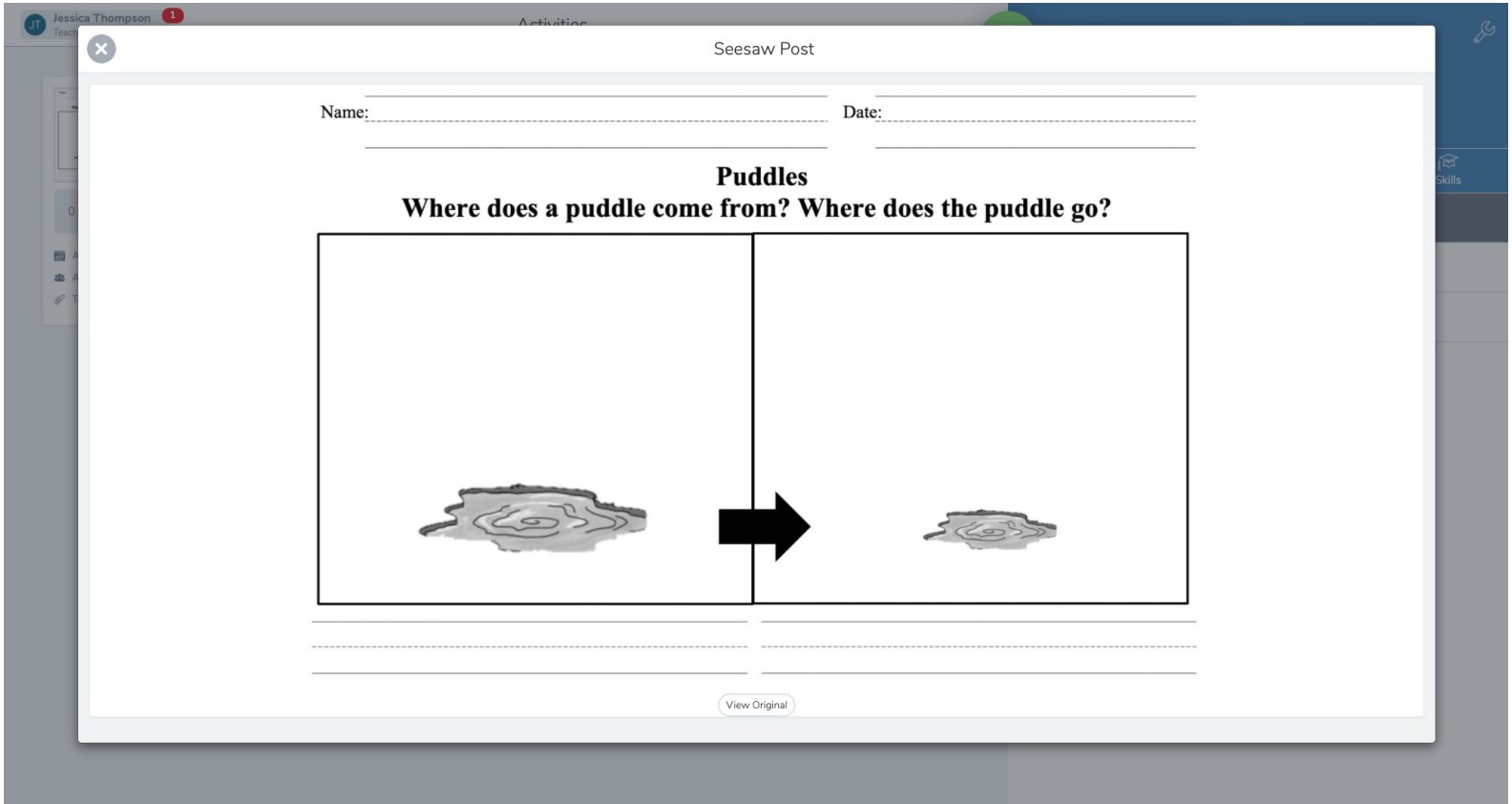
Final model



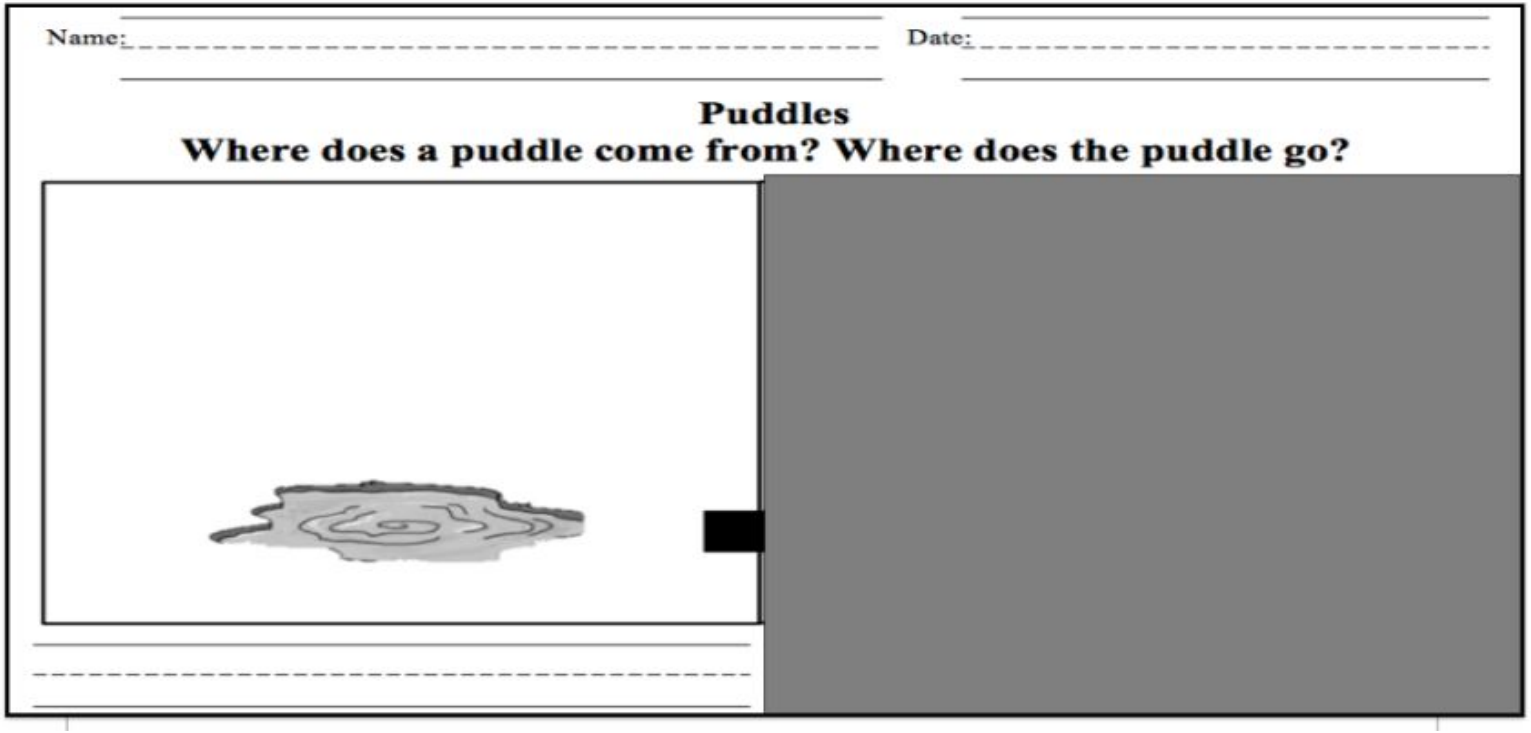
What stayed consistent?
What changes do you notice?

COVID 19 Digital Option

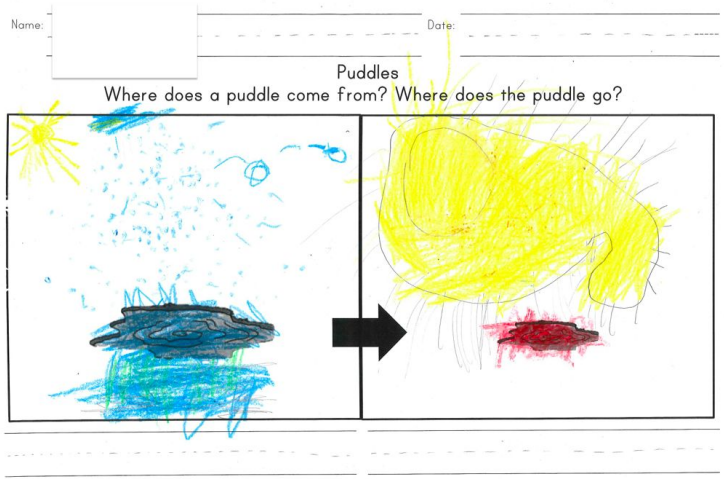
Dominant view: Access, inclusion & achievement

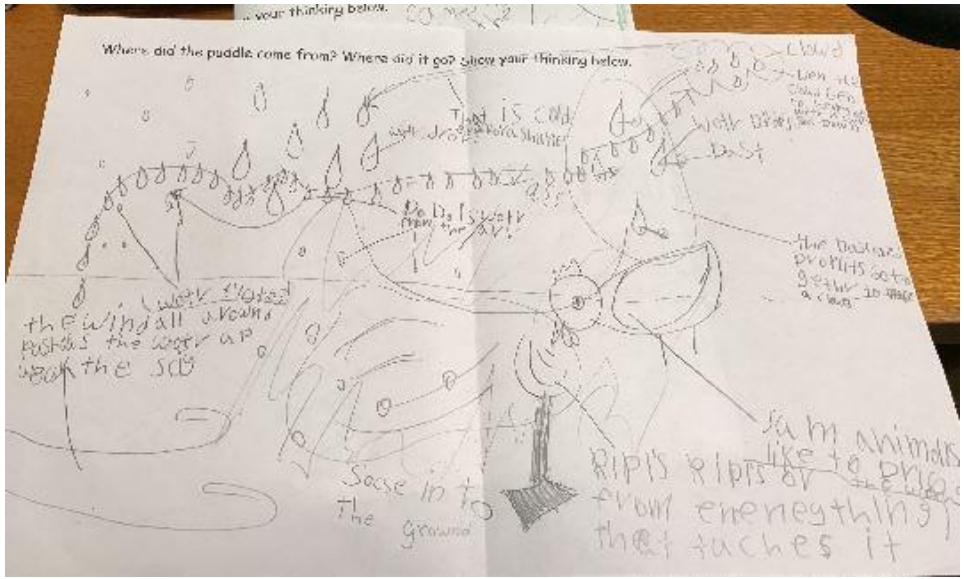


Modeling: Maximizing opportunities for students to show ideas (Scaffolding)



Modeling: Maximizing opportunities for students to show ideas (Colors, arrows, zoom-ins...)





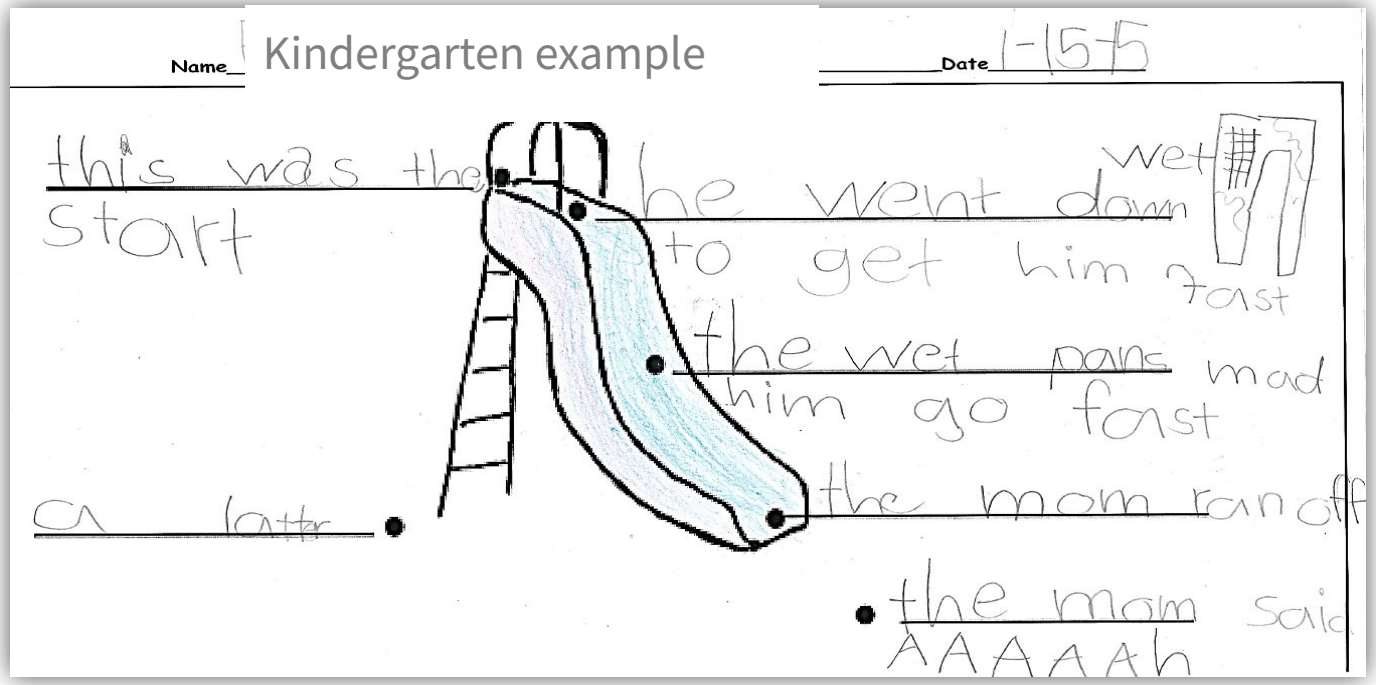
Modeling: Maximizing opportunities for students to show ideas (Collaboration)

Agree 

 Agree + Add On

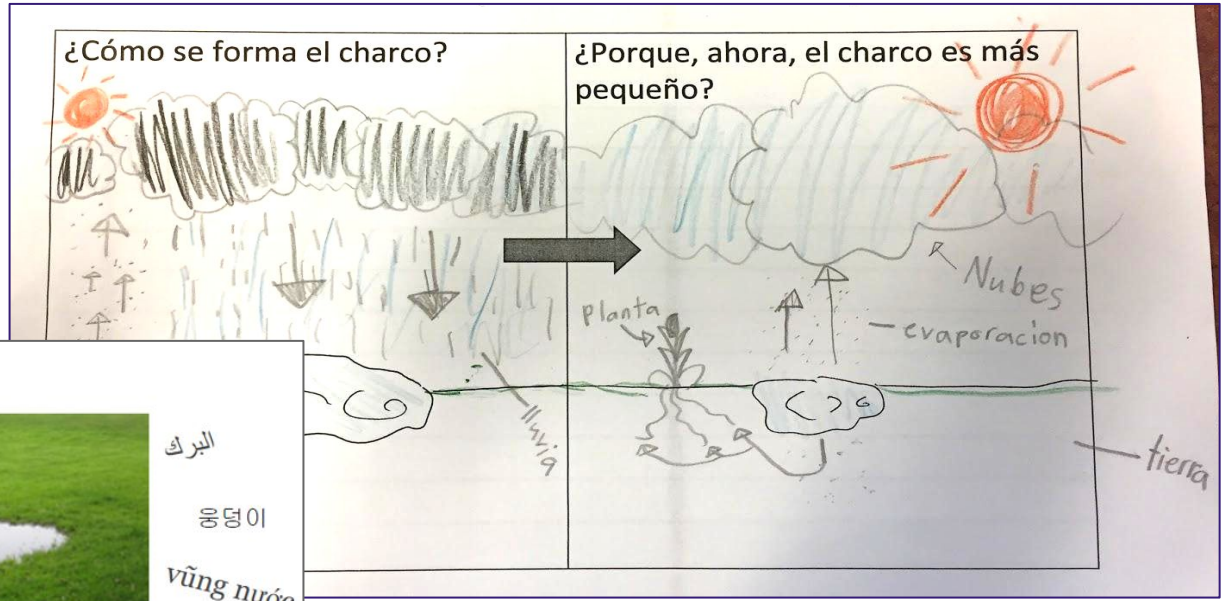
Kindly Disagree 

Modeling: Maximizing opportunities for students to show ideas (Everyday experiences)



Modeling: Maximizing opportunities for students to show ideas (Language)

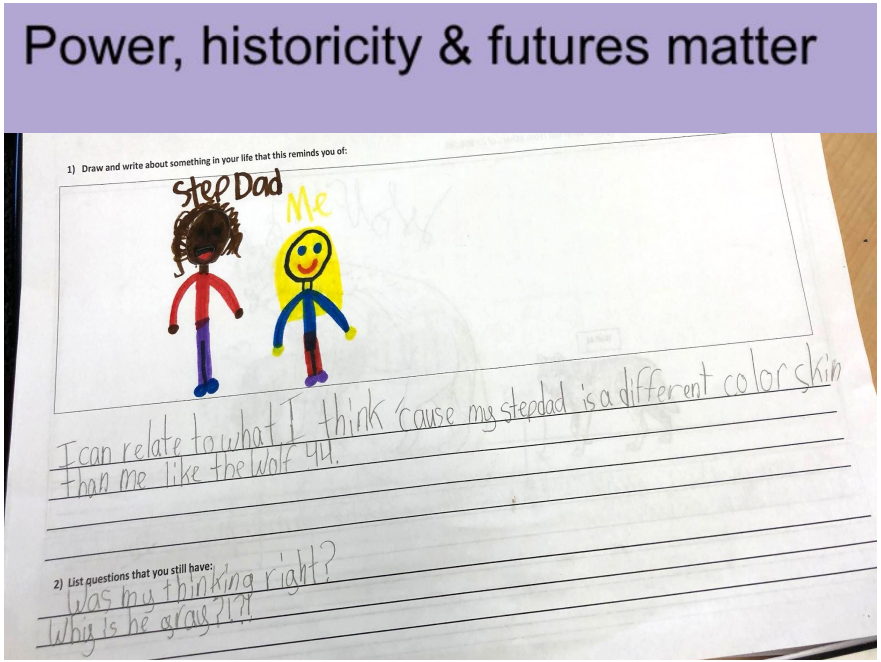
Broadening Languages of Science



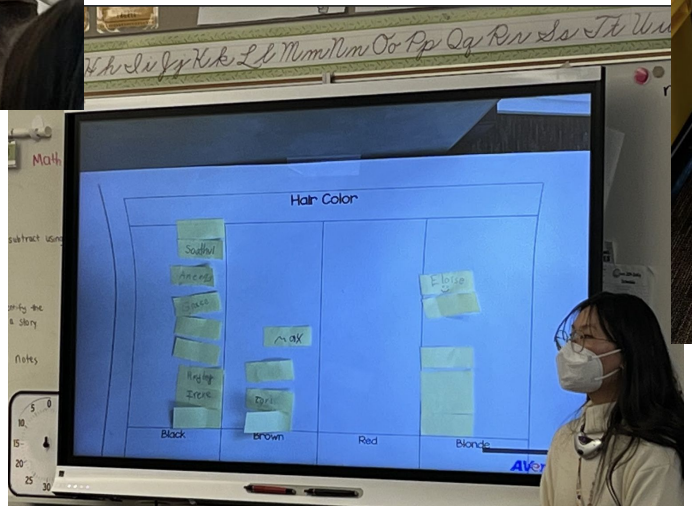
Connecting to students' lived experiences
Back-side of the models

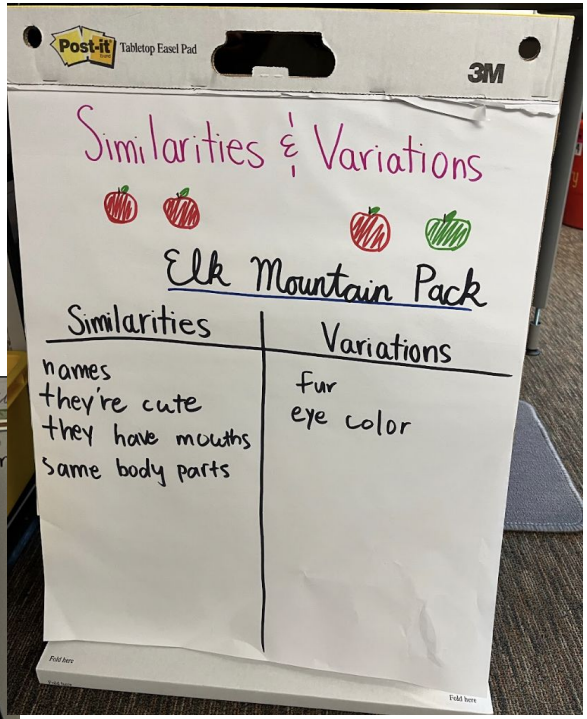
- Draw or write something about what this reminds you of.
- List questions you still have.

While we have data from students, we do not have much evidence from classroom observations to know HOW teachers integrated students' lived experiences from this elicitation.



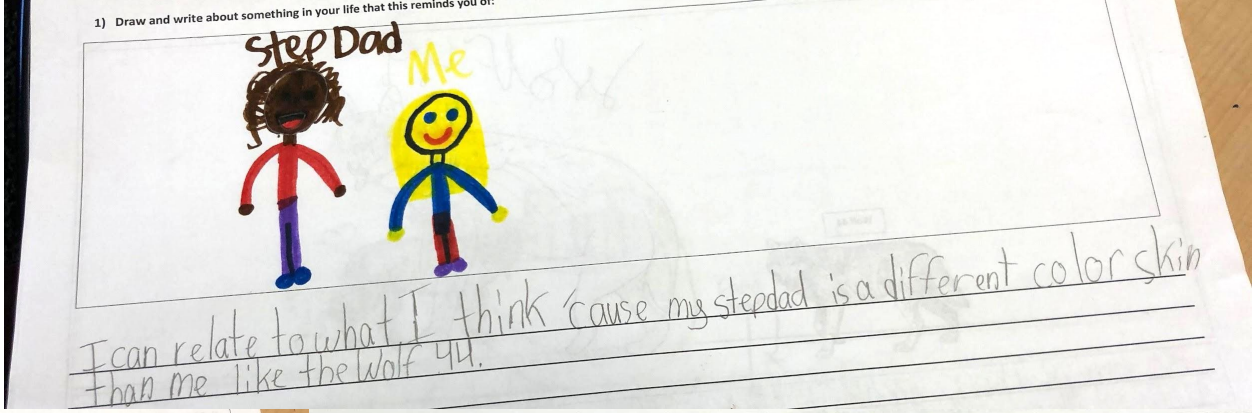
Connecting to Multiple Identities & Phenotypes

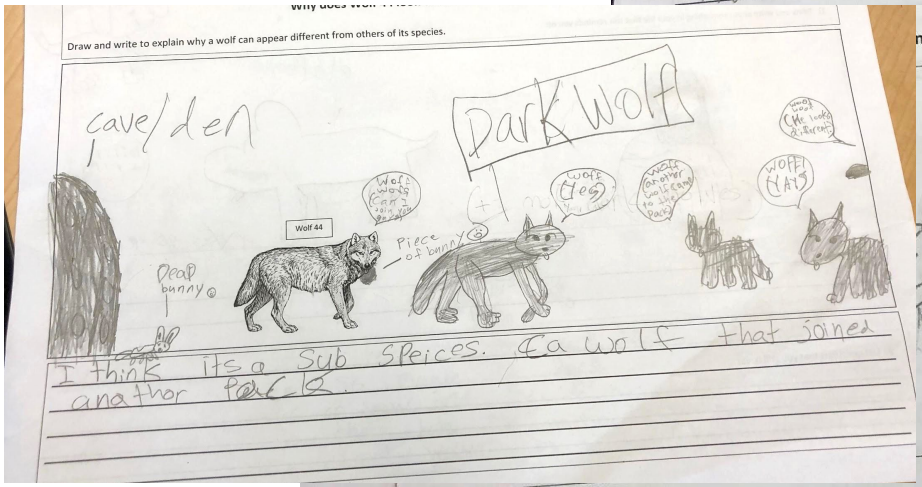


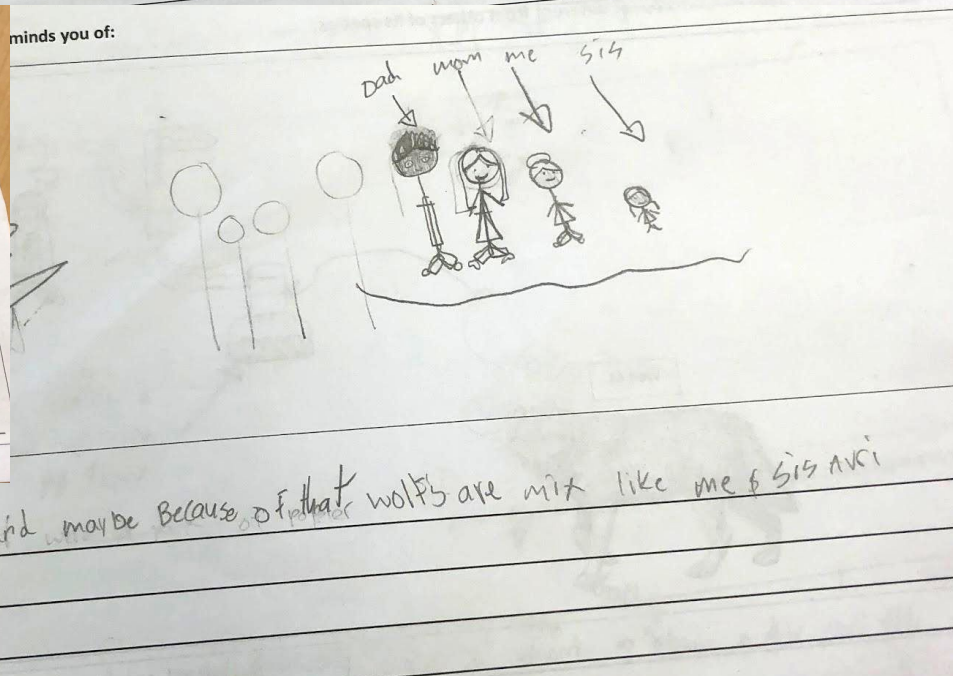


Framing modeling tasks by Making Space to Talk about Language and Race

3rd grade This reminds me of...







Modeling and Multiple Perspectives with Phenomena that Matter

Nature-Culture Relations & Ecological Caring

Culture, Families & Communities as Rightfully Belonging

Broadening Languages of Science

Power, historicity & futures matter

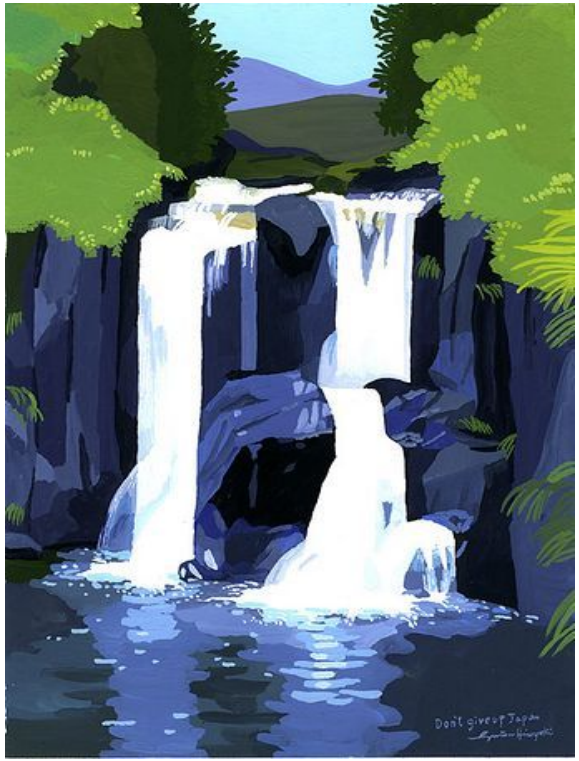

ART
THE DOG

Orient toward justice:"Creating equitable learning opportunities depends critically on teachers' skill in seeing and hearing students' ideas and reasoning as connected to science (as opposed to being off topic, or, worse, disruptive)."

—Bang, Brown, Calabrese Barton, Rosebery & Warren (2017, p. 36)

Pause, Reflect, Share…

1) What did you notice in the videos, about student learning, about teacher learning?
2) How are you thinking about the dominant and critical equity axes in your work?



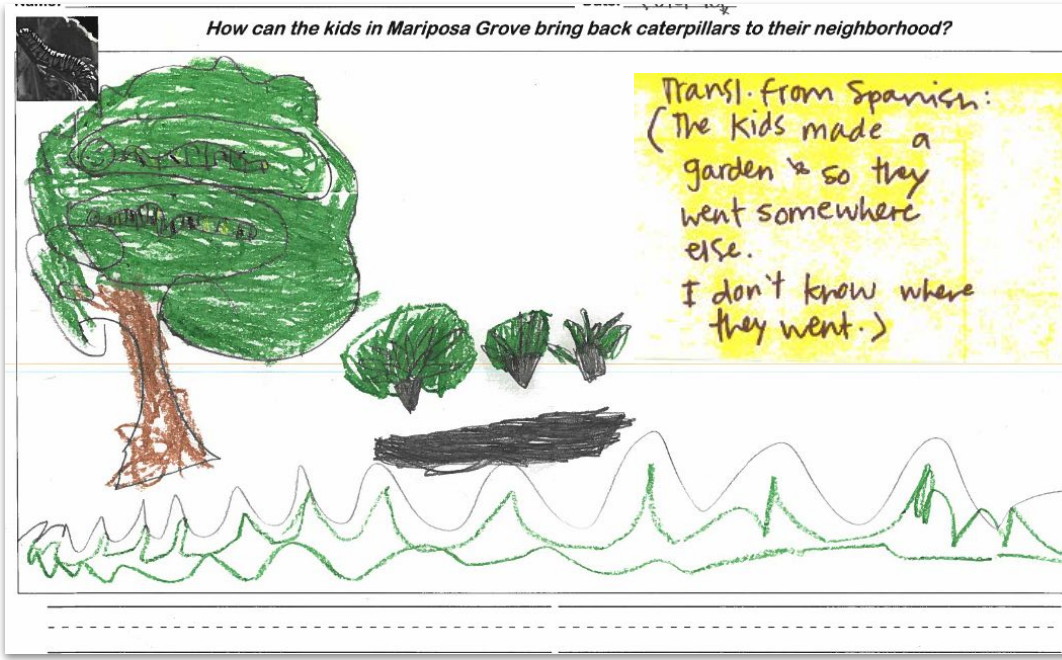
Teacher Learning

K example: Learning about student assets

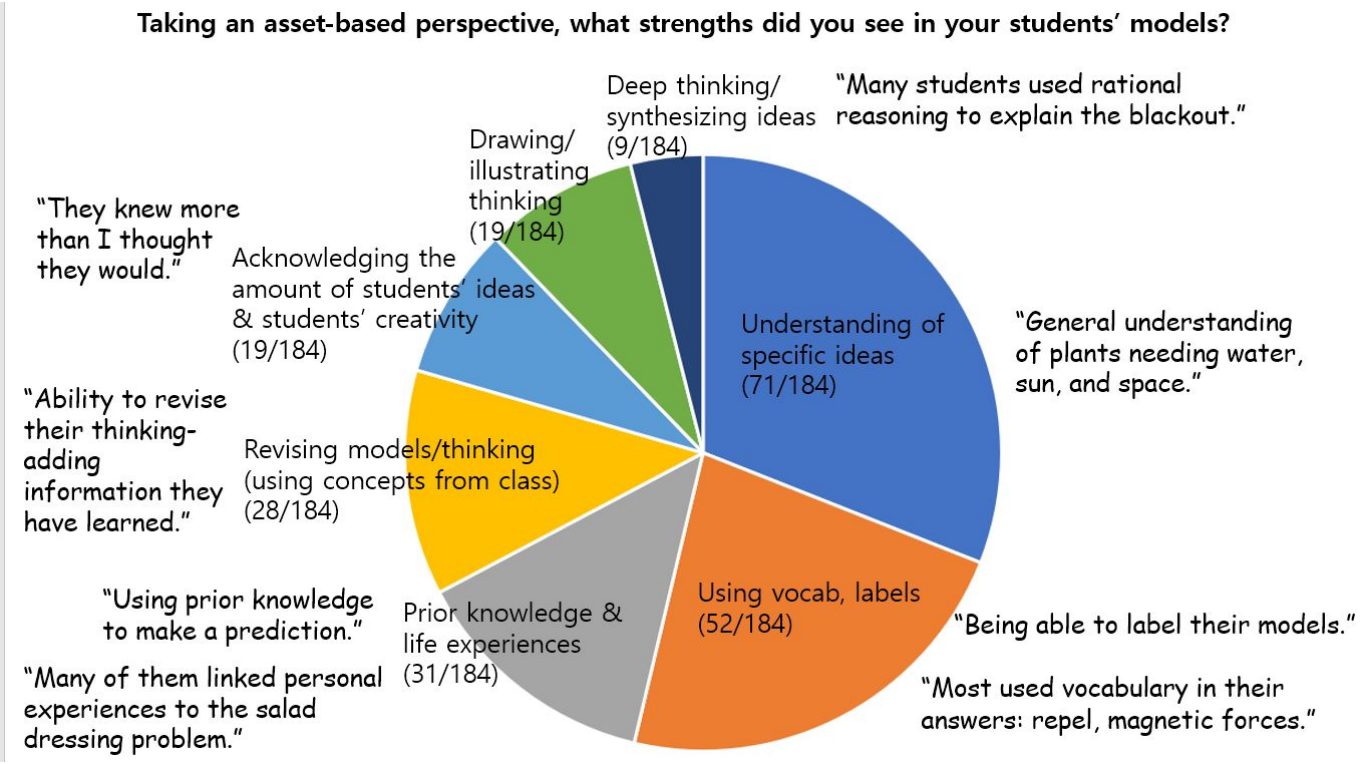
The student is Marisol, who came to the US from Guatemala this summer. She speaks Mam and a little Spanish and is learning Spanish and English in school! She loves school and her family says when she gets home she talks about science as one of her favorite parts.

When I told the kids the story of Mariposa Grove and posed the question of why weren't there any caterpillars after the field was turned into a garden, I made sure to tell the story in English and Spanish, and using the pictures from the ppt as visuals. It was amazing because Marisol spent most of her childhood in a rural farming community in Guatemala. She is a super talented artist and was able to explain to me that because the kids made a garden, the caterpillars went somewhere else to find food.

In thinking about Marisol's modeling, her background knowledge was key to her puzzling through the phenomenon. The modality of drawing and orally communicating her ideas in Spanish helped the class access these ideas. And the storytelling in multiple languages with visual scaffolding helped her to enter into investigating the problem in the first place.

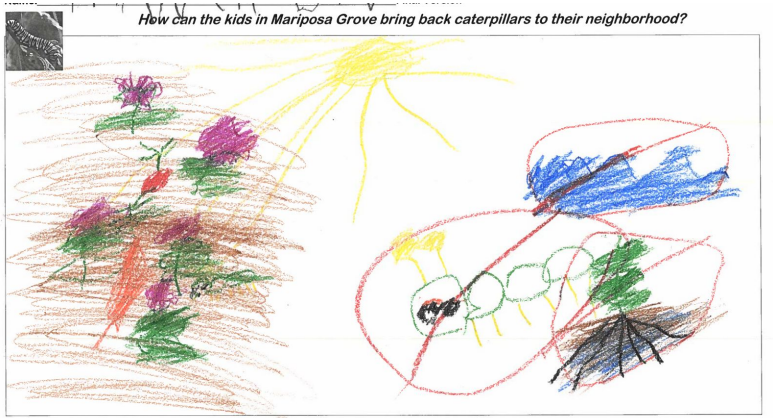


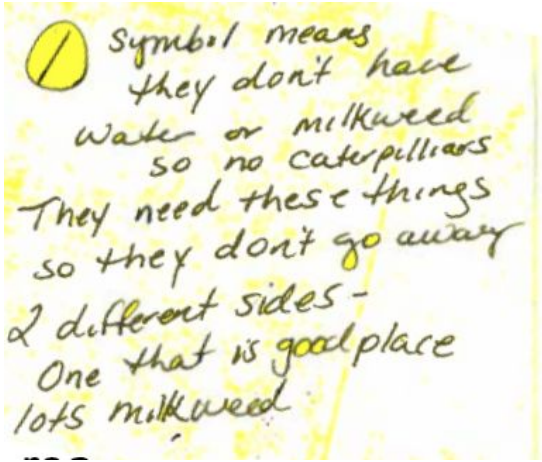
Teachers' perceptions of students' strengths in modeling (November 6, 2020 N=184)



Challenging Assumptions

K teacher: you see deeper into what they're really thinking and sometimes a student that you think that is really at a really low level can surprise you by the picture and by what they're trying to say in the picture. I have this one kid, he hated writing, writing time for him was the worst time ever. But when it came to science. Wow. It was like, I saw a different child just because of what he produced for those models. So again, with different perspective, it made me realize that he had more potential that I was giving him credit for. Because sometimes we create our own biases. (Interview 05/20/20)

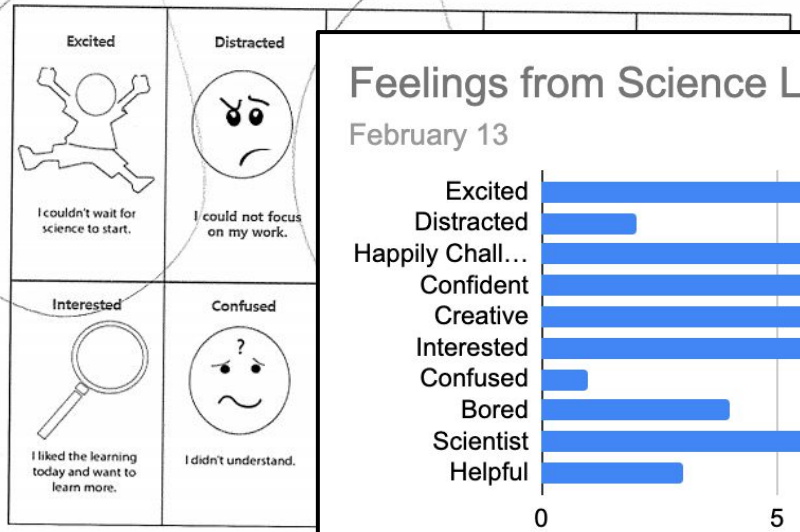




K-2

Your Thoughts on Our Science Learning!

1. Circle how you felt in science class today (you can circle more than 1 feeling).

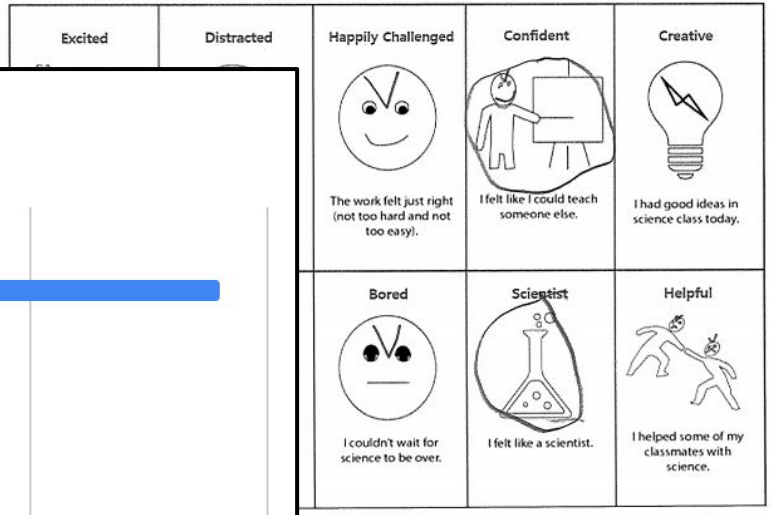


2. What do you like most about our science unit?

That we were using models.

Your Thoughts on Our Science Learning!

1. Circle how you felt in science class today (you can circle more than 1 feeling).



science unit?

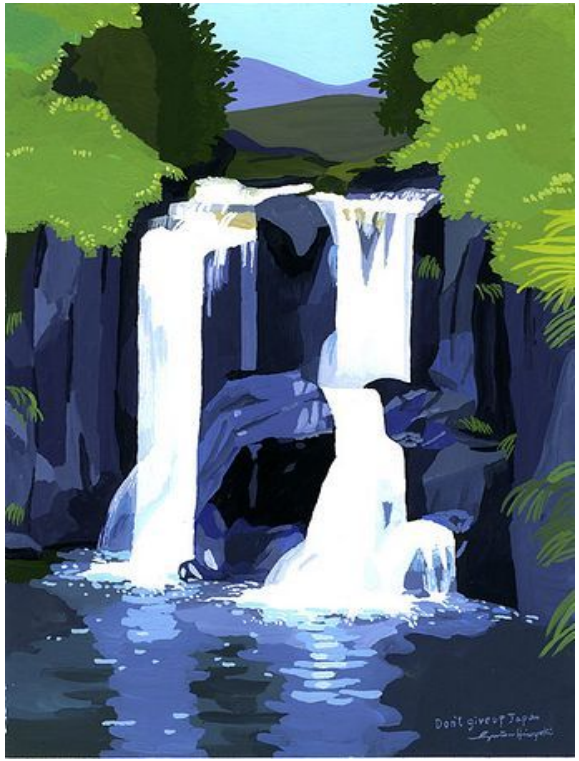
I was saving big words and I had a lot of ideas.

Orient toward justice: Poverty, race, gender or being a language learner is not a learning disability. It is an opportunity to interrupt oppression.

"If education is to empower culturally and linguistically diverse students it must be transformative. Empowerment can be described as student academic competence, self-efficacy (belief in one's ability) and initiative."
-Dr. James Banks

Pause, Reflect, Share...

1) What did you notice in these teacher learning stories?
2) How might you collect and center teacher stories of justice-centered teaching in your work?

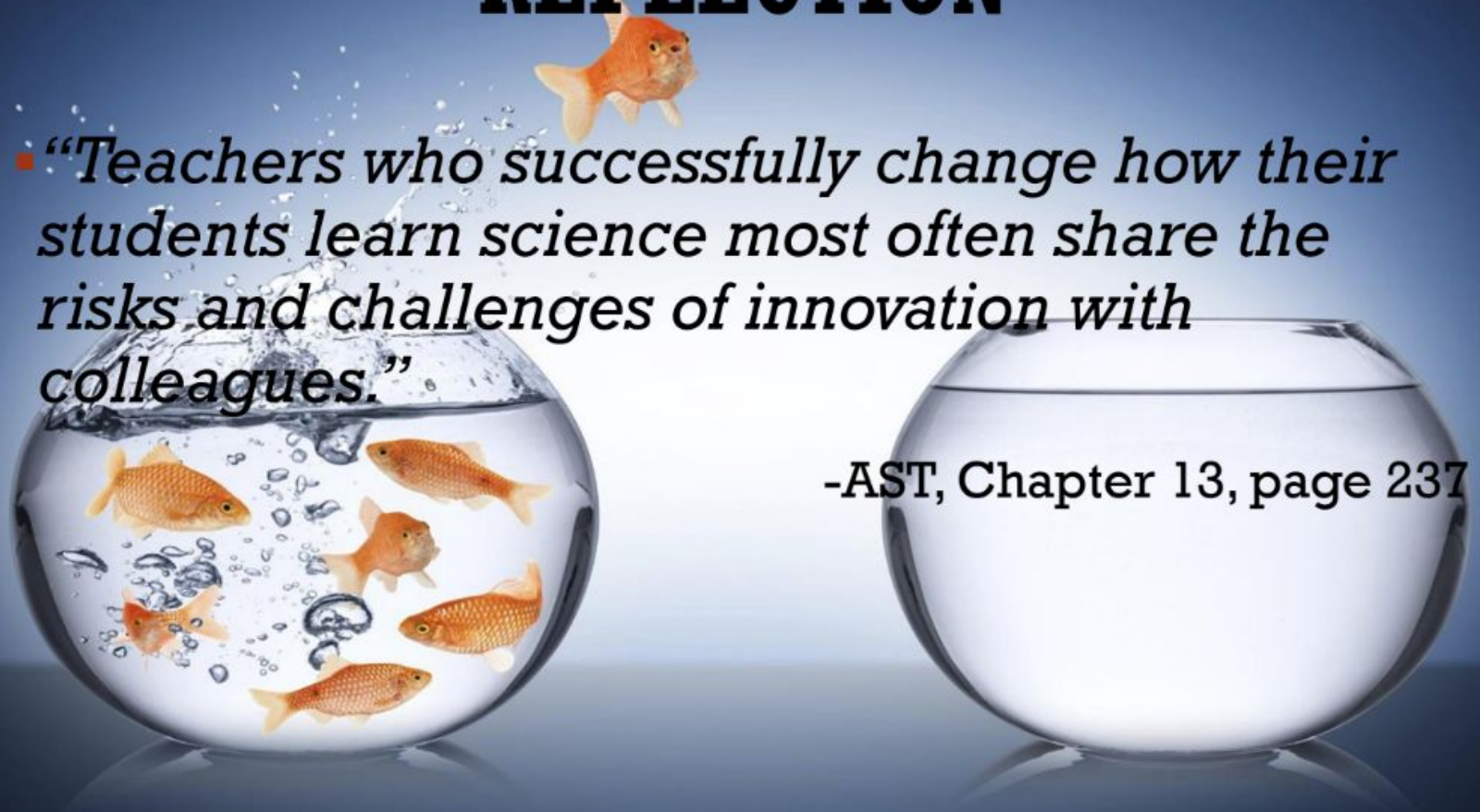


Teacher Teams Learning

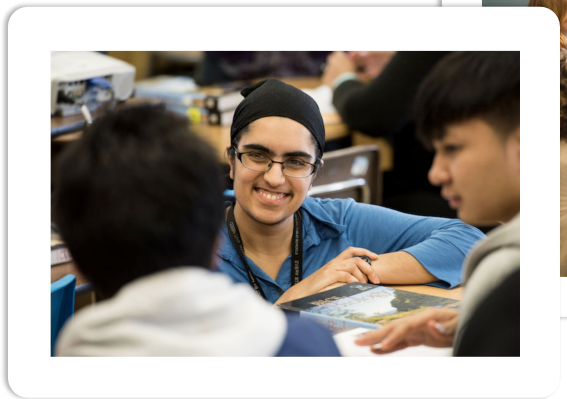
REFLECTION

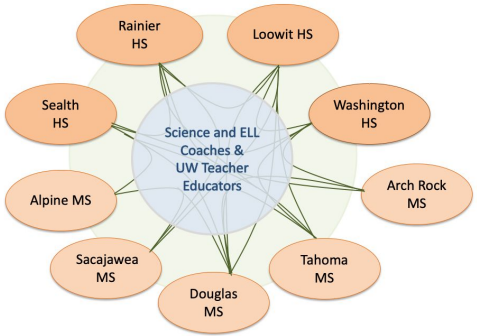
- *"Teachers who successfully change how their students learn science most often share the risks and challenges of innovation with colleagues."*

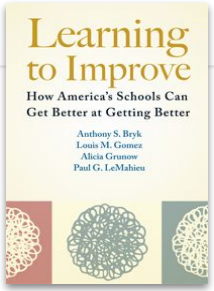
-AST, Chapter 13, page 237

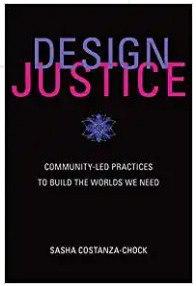


A systems-level challenge to improve ambitious and equitable curricula & instruction









Design Justice Principles

Design justice rethinks design processes, centers people who are normally marginalized by design, and uses collaborative, creative practices to address the deepest challenges our communities face.

Principle 1

We use design to sustain, heal, and empower our communities, as well as to seek liberation from exploitative and oppressive systems.

Principle 2

We center the voices of those who are directly impacted by the outcomes of the design process.

Principle 3

We prioritize design's impact on the community over the intentions of the designer.

Principle 4

We view change as emergent from an accountable, accessible, and collaborative process, rather than as a point at the end of a process.*

Principle 5

We see the role of the designer as a facilitator rather than an expert.

Principle 6

We believe that everyone is an expert based on their own lived experience, and that we all have unique and brilliant contributions to bring to a design process.

Principle 7

We share design knowledge and tools with our communities.

Principle 8

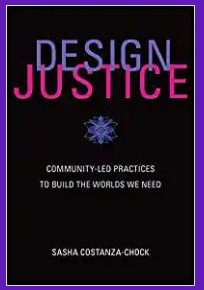
We work towards sustainable, community-led and -controlled outcomes.

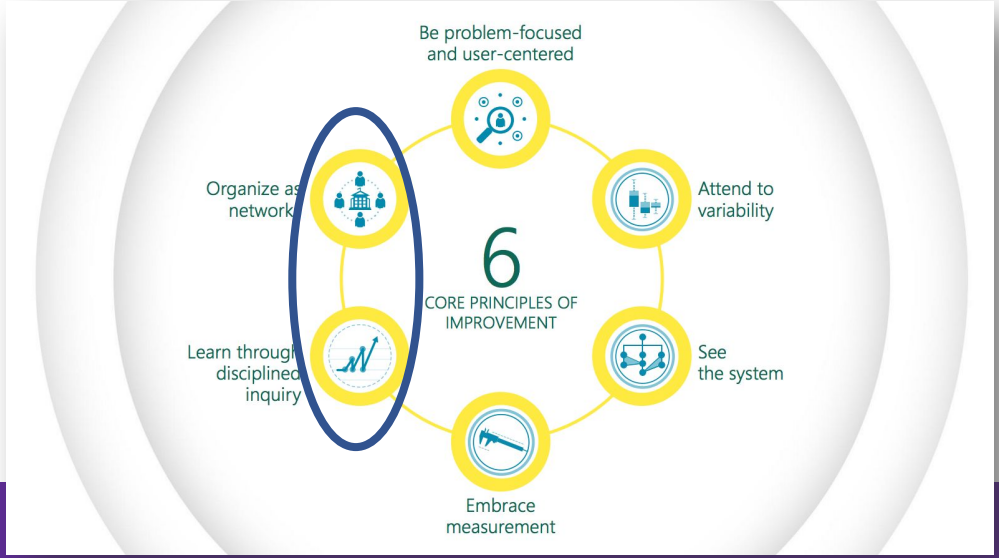
Principle 9

We work towards non-exploitative solutions that reconnect us to the earth and to each other.

Principle 10

Before seeking new design solutions, we look for what is already working at the community level. We honor and uplift traditional, indigenous, and local knowledge and practices.

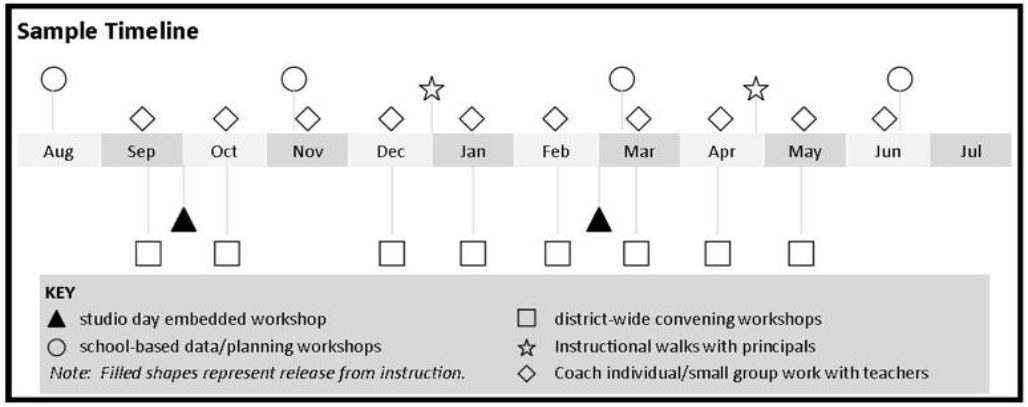




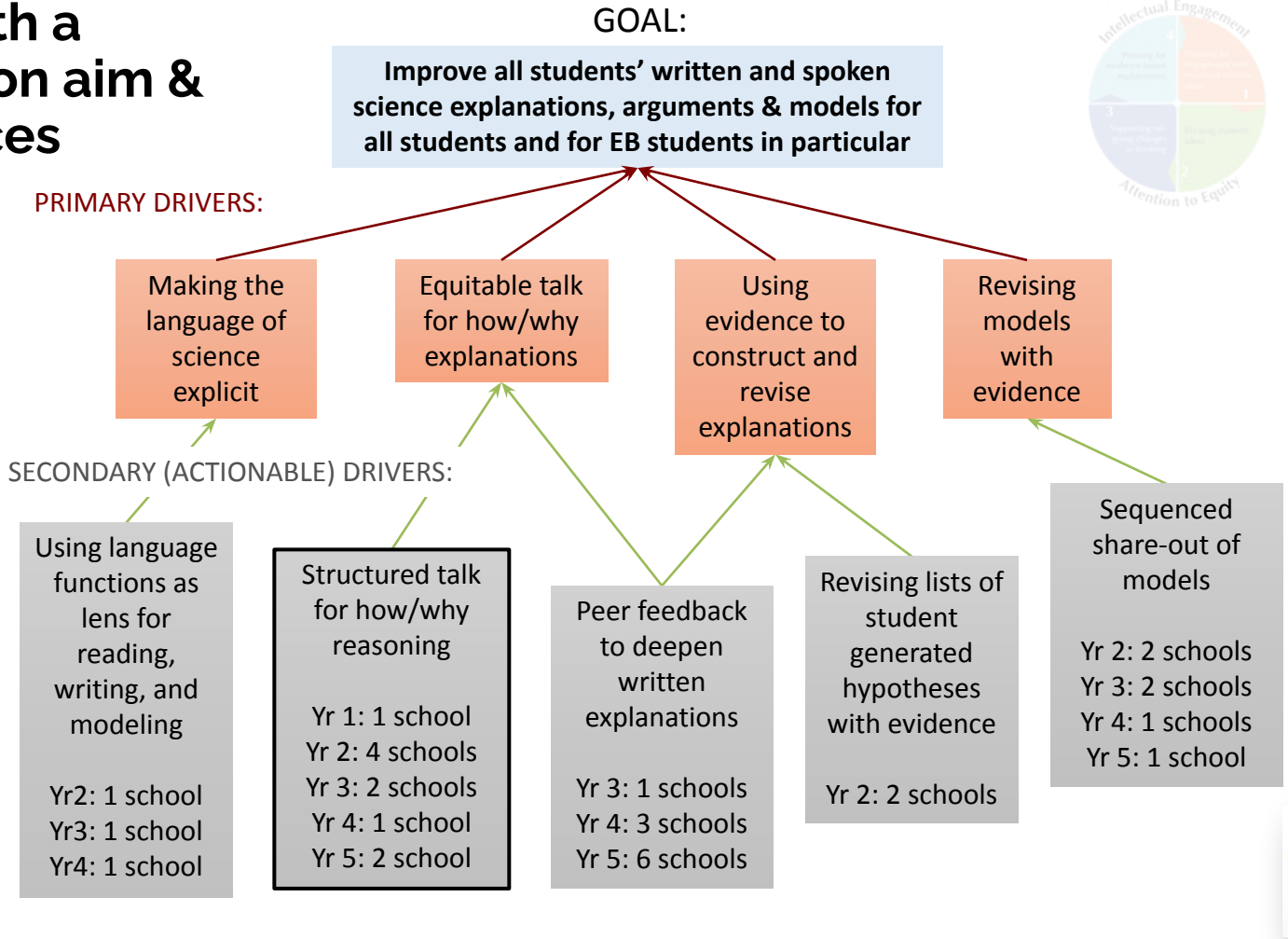
Develop networks that improve instruction by asking: Which practices work? Under which conditions? And for whom?

Bryk, Gomez, Grunow, LeMahieu, 2015

Organizing as a network & engaging in disciplined inquiry

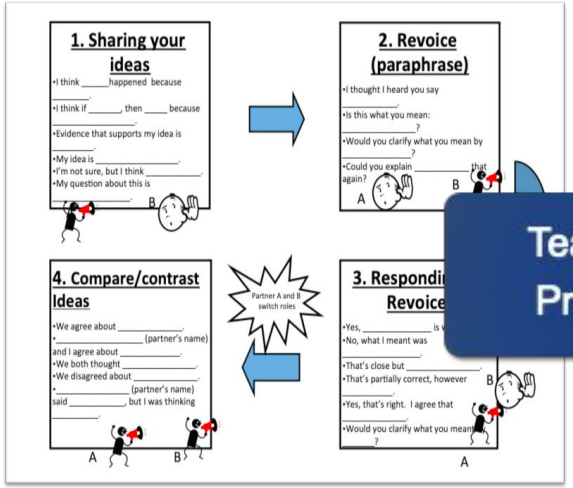


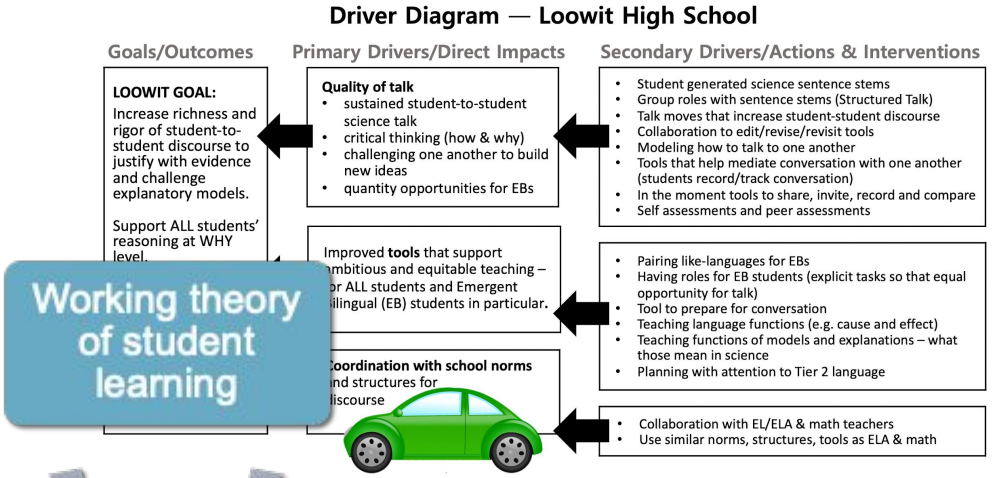
NIC with a common aim & practices



Learn through disciplined inquiry

Learning Loops





Working theory of student learning

Teaching Practice

Practical measurements

When you engaged in structured talk with a partner, which of the following did you try? (check ALL that apply

- ☒ I shared my idea
- ☒ I listened to my partner's idea
- ☒ I agreed with my partner's idea
- ☐ I could revoice my partner's idea
- ☒ My partner and I looked for similarities and differences in our ideas
- ☒ I used a sentence stem to explain my idea
- ☐ Other _____

What went well in your discussion? What could have gone better?

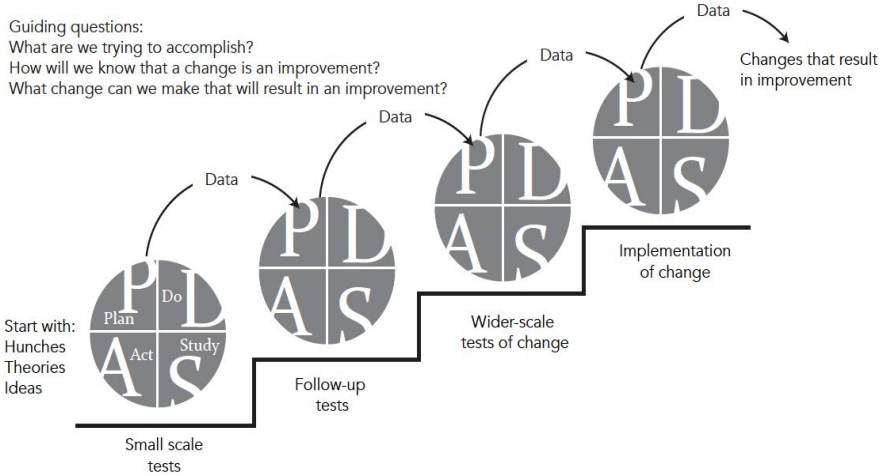
talked about our own thinking ab... hypothesis or our lab and what are the optimal ranges of an enzy...

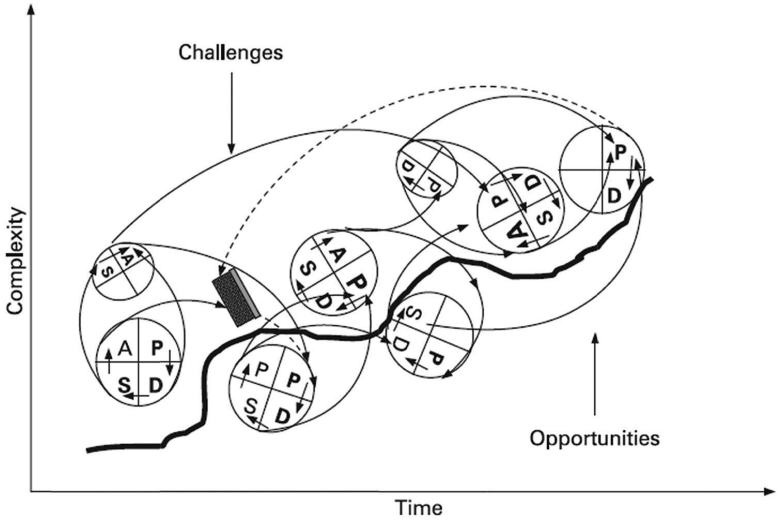
Everything went well in my discussion because we both listened to other and was able to build off our ideas.

Explain one thing in this unit that you understand better or differently after talking with your partner today.

Now understanding about how enzymes catalases works and h... have a better then are effected by different variables.

What can we do to improve?
PDSA Cycles with PLCs





P = Plan D = Do = Barrier —— = Direct flow of impact
S = Study A = Act ----- = Lingering background impact Arrowhead = Feedback or feedforward
Different sizes of letters and cycles and bold letters = denotes differences in importance/impact

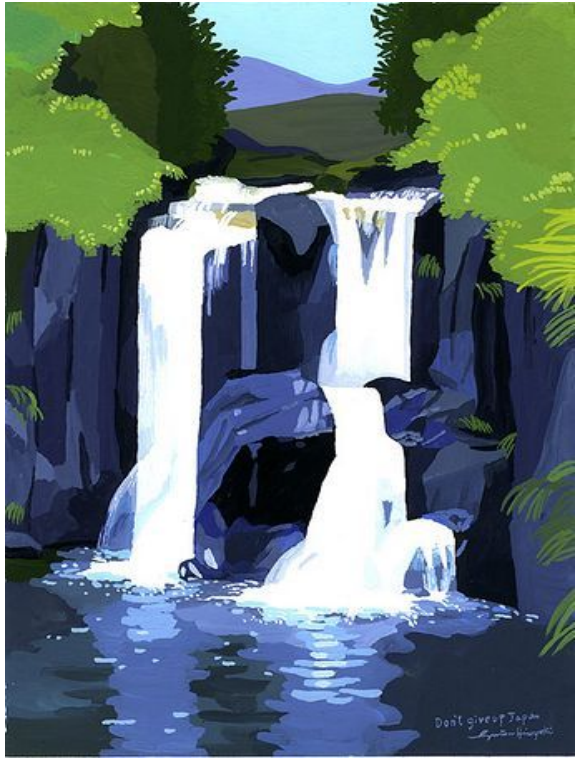
Researcher Learning

From assimilation to transformation: Questions for researchers to ask

- What happens when partners disagree about what we mean by equity? How will we work on our most critical edges together?
- How can we hold ourselves accountable to maintaining a critical perspective, in the face of pressure to move quickly and efficiently?
- How can we ensure that teachers and researchers of color are listened to and their ideas and concerns are taken seriously rather than silenced?
- Who else do we need to be in conversation with?
- How/when do we flatten hierarchies such that people in positions of power cannot threaten junior researchers and teachers, particularly women of color?
- If the research team is white, how can we critically examine whiteness and the role it plays in science education and our own research?
- What work needs to be done or undone to create counterspaces for acts of resistance? (Solórzano & Yosso, 2002)

Pause, Reflect, Share...

1) Which of these questions resonate with you?
2) What might be a good starting point for yourself and your team?



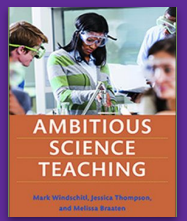
Website: ambitiousscienceteaching.org

Facebook: Advancing Ambitious and Equitable Practices (ask to join!)

Email: jjthomps@uw.edu

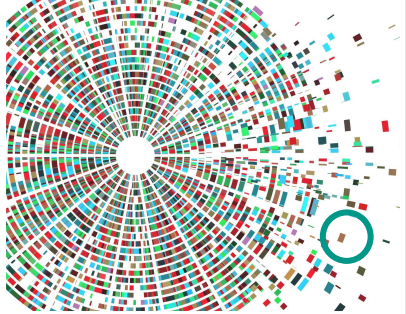
Twitter: @JessicaATP

JSMF

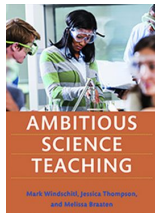


NSF

Theory of Classroom learning



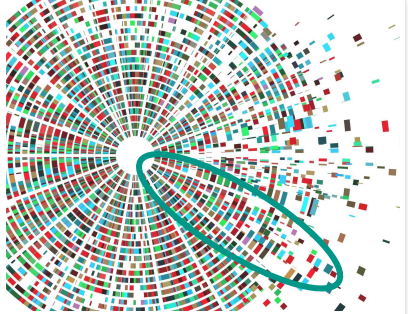
Ambitious Science Teaching & Rigor & Responsiveness. Engaging students' prior knowledge as an equity move to help learners feel connected & respected for their experiences (Kang, Windschitl, Stroupe, & Thompson, 2016; Stroupe, 2014; Thompson et al., 2016; Windschitl, Thompson, & Braaten 2018)



Culturally Responsive Teaching. Building on students' funds of knowledge with a focus on culturally & linguistically diverse students' knowledge (Hammond, 2014; Suárez, 2020; Villegas Lucas, 2007)

Critical Approaches to Science Teaching. Leveraging science practices to address historicized inequities and injustices (Calabrese Barton & Tan 2020; Gutierrez, R., 2002; Paris & Alim, 2014; Winn, 2018)

Theory of Teacher Learning



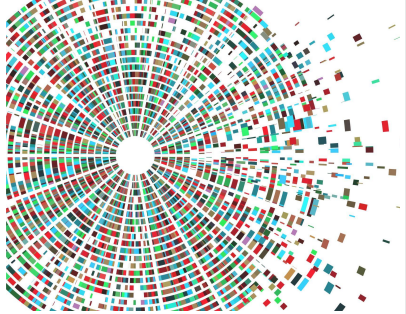
Social Networks. Supporting teachers in maintaining a stance towards inquiry, focus on student learning, and support group collaboration (Borko, Koellner & Jacobs, 2014; Cheung, Reinhardt, Stone & Little, 2018; Thompson, Richards & Shim, 2019; Wenner & Campbell, 2017)

Situated Professional Learning Communities. Building capacity for sustained learning and improvement (Cobb, McClain, de Silva Lamberg, & Dean, 2003; Jackson & Cobb, 2012: Richmond & Manakore, 2011)

Practice-Oriented Teacher Development. Supporting professional learning of practices, tools and principles. (Thompson et al., 2013, Windschitl, Thompson, Braaten & Stroupe 2020; Thompson, Mawyer, Johnson, Scipio & Luehmann, 2020)

Development of Critical Consciousness. Supporting teachers to notice for equity and equity in action (Patterson, Higgs & Athanses, 2019; VanEs & Hand, 2017)

Theory: RPPs & NICs



RPPs. Research-practice partnerships have strong potential to generate and improve collective knowledge and novel solutions over time (e.g., Coburn & Penuel, 2016):

- Mutualistic collaborations between practitioners and researchers
- Oriented toward situated problems of practice

NICs. Across institutions, a commonly shared set of core practices, along with its tools, could evolve over time to improve and innovate within the work of teaching (Bryk, Gomez, & Grunow, 2011; Hiebert & Morris, 2012)

For me will be interesting to hear the basics of your Framework and, from there, your main findings and your view about which may be the sensitive new challenges.

I’m interested in how pre-service teachers learn to participate meaningfully in model-based investigations in and how they learn to integrate aspects of meaningful engagement into their own teaching practice. We designed tools and supports for the practices of planning, enacting and reflecting on model-based investigations and are currently investigating how written reflections on their own enactments of such investigations can help us to understand their professional development better. Questions we're asking ourselves are:

1. How can improvement cycles be used to improve our tools for co-planning model-based investigations and how can student feedback on our tools be integrated into them?
2. How can we support the written reflections of our students in multiple reflection sessions, in order to establish meaningful practice for them instead of our students re-iterating on the same ideas of participation?Perhaps nothing new but the insights from a long project are certainly exciting. I would like to hear about the Authors’ perspective on this to look at what others are doing in situations described in the paper, which is comparable to ours.
3.
4. +getting an insight into how "providing more equitable learning opportunities for diverse students " is implemented
5.
6. +how teachers are supported to distribute Epistemic Agency and how they see it is picked up by pupils