Strengthening Infrastructures for Promoting Equity in Mathematics Education through Research-Practice Partnerships

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Location of Slides

You can find the slides for this presentation here:

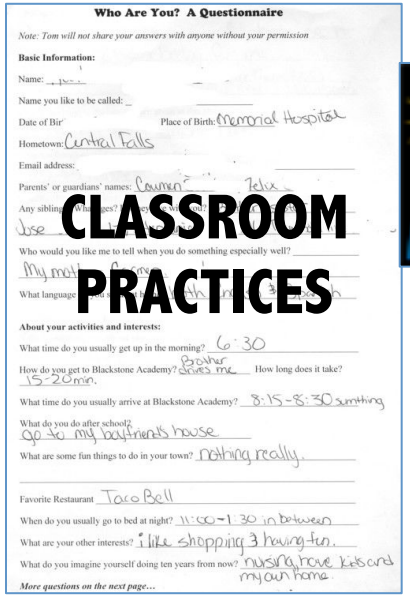
Presentation Overview

- The **present moment:** Scaling and sustaining equitable reforms in a time of virulent nationalism and fragmentation
- The **opportunity:** Research-practice partnerships that foreground equity
- The **infrastructure:** The one a partnership can build and one that is needed for partnerships

A Time of Virulent Nationalism

- Story that captures student feelings about the times we are living in (American Educator piece)
- Frustrated, because the notion of education as a civil right for all students is under direct threat

There are existence proofs…


Who Are You? A Questionnaire

Note: Tom will not share your answers with anyone without your permission

Basic Information:

Name:

Name you like to be called:

Date of Bir Place of Birth: Memorial Hospital

Hometown: Central Falls

Email address:

Parents' or guardians' names: Carmen Felix

Any siblin

Jose

Who would you like me to tell when you do something especially well?

My mat

What language

About your activities and interests:

What time do you usually get up in the morning? 6:30

How do you get to Blackstone Academy? Brother drives me How long does it take? 15-20min.

What time do you usually arrive at Blackstone Academy? 8:15-8:30 sumthing

What do you do after school? go to my boyfriends house

What are some fun things to do in your town? nothing really.

Favorite Restaurant Taco Bell

When do you usually go to bed at night? 11:00-1:30 in between

What are your other interests? i like shopping & having fun.

What do you imagine yourself doing ten years from now? nursing, have kids and my own home

More questions on the next page…

CLASSROOM PRACTICES

SimCalc

PROGRAMS

long beach unified school district

Union City Board of Education UC

UNION CITY PUBLIC SCHOOLS

DISTRICTS

Railside

CLASSROOMS, SCHOOLS, TEACHER TEAMS

CARNEGIE MATH PATHWAYS

NETWORKED IMPROVEMENT COMMUNITIES

The Challenge of Sustainability

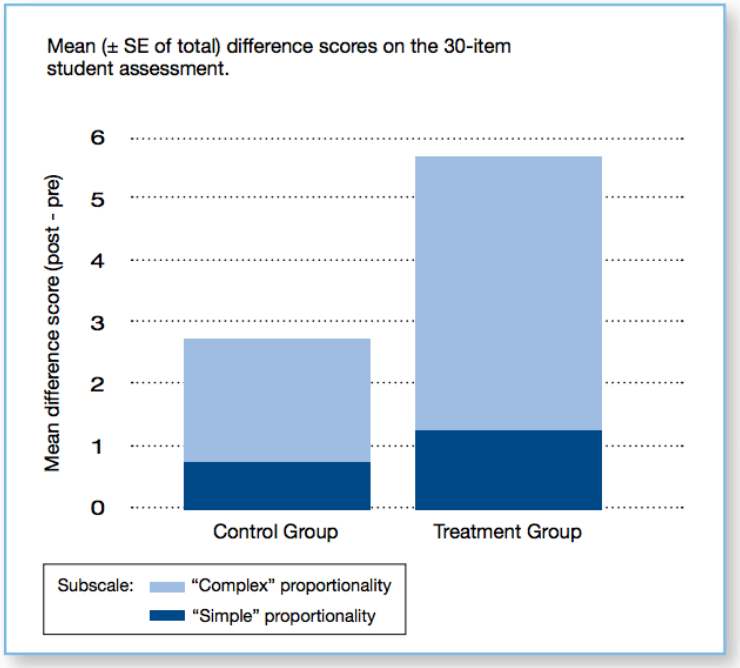


Figure 1. Student gain scores aggregated by teacher.

Positive impacts for students at all levels of achievement, for Latino students, for girls and boys

Factors related to sustainability:

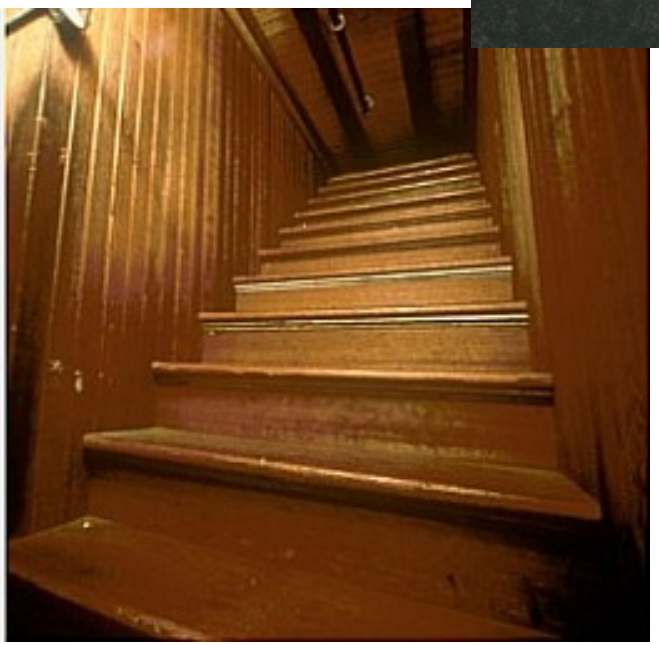
- Baseline scores on complex mathematics of students in the prior year
- Perceived coherence of intervention with local goals of schools and districts
- Ratings of the quality of professional development

What We Need

- Infrastructure
- Better infrastructures for
  - Keeping equity at the center
  - Designing collaboratively in ways that include all stakeholder voices
  - Building greater horizontal and vertical coherence in systems

Infrastructures

Educational Infrastructures: An Analogy



Research-Practice Partnerships as Infrastructures

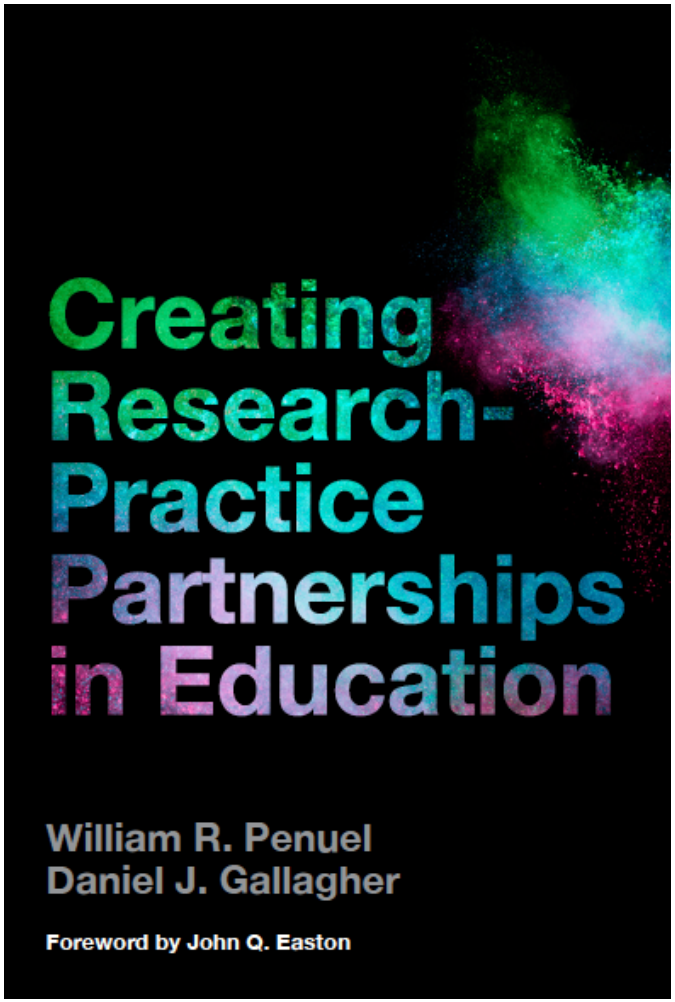
Research-Practice Partnerships as Infrastructures

- Research-Practice Partnerships: A definition
- Lines of work within the Inquiry Hub partnership:
  - Centering equity in analysis of curriculum and student experiences
  - Collaboratively designing curriculum that is coherent and meaningful from the student perspective
  - Building horizontal and vertical coherence through expanding assessment

Research-Practice Partnerships

long-term collaborations between educators and researchers that are organized to investigate problems of practice and solutions for improving systemic outcomes.

http://researchandpractice.org/toolkit



A Continuum of Arrangements

Program hires or assigns researchers to study it.

Research team approaches program to participate in a study.

Educators define the problems to solve and goals of the engagement

Researchers define the problems to solve and goals of the engagement

A Continuum of Arrangements

Educators as client or customer
Researchers as consultants

Program hires or assigns researchers to study it.

Educators define the problems to solve and goals of the engagement

Researchers as knowledge builders
Educators as subjects

Research team approaches program to participate in a study.

Researchers define the problems to solve and goals of the engagement

A Continuum of Arrangements

Program hires or assigns researchers to study it.

Educators define the problems to solve and goals of the engagement

Research Practice Partnership

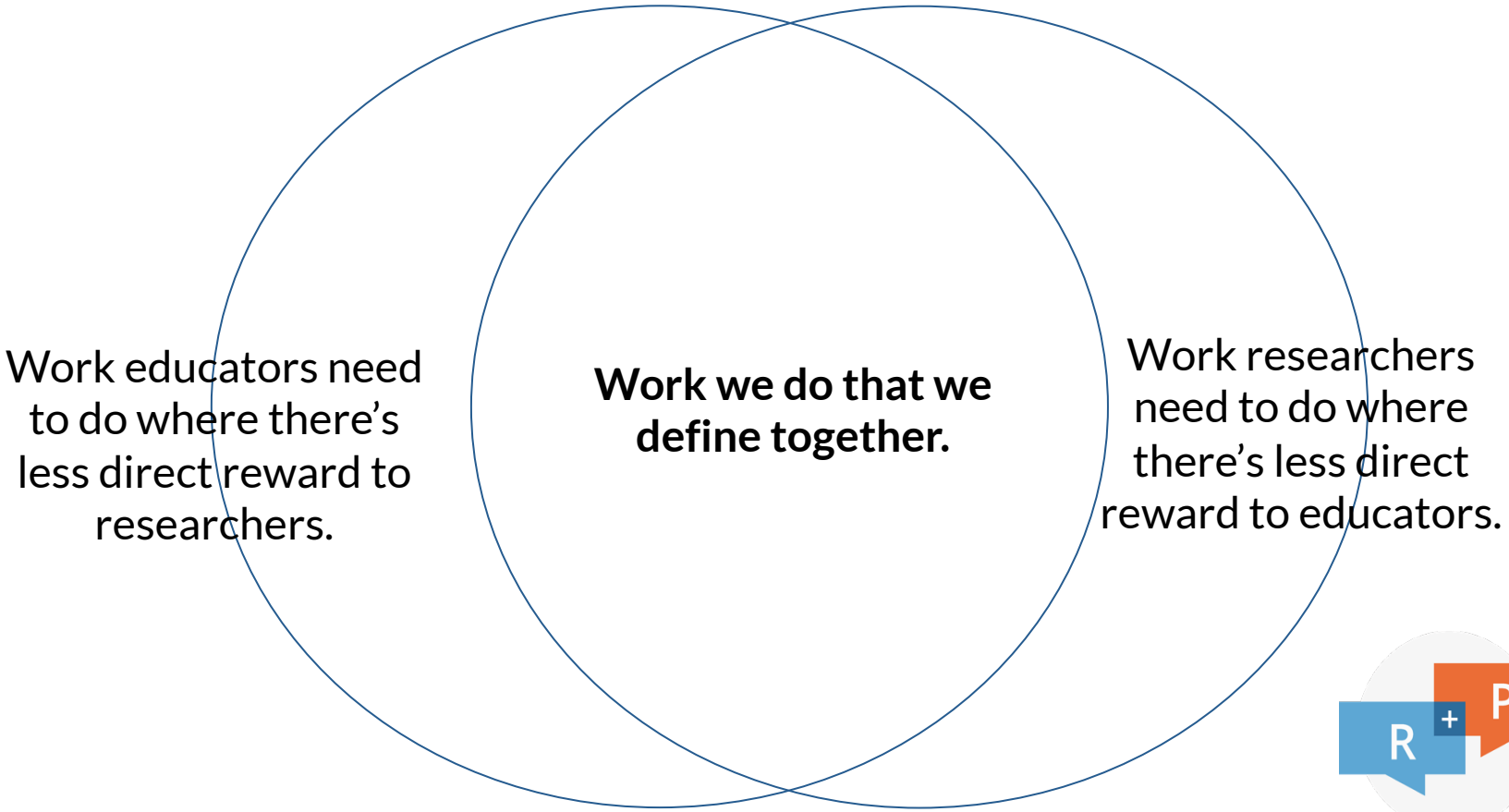
Research team approaches program to participate in a study.

Researchers define the problems to solve and goals of the engagement

Key Characteristic: RPPs Are Mutualistic

- Commitment to work on projects that benefit all parties
- Negotiate in an ongoing way the focus of joint work
- Promotes view that all perspectives are valued in the search for solutions

Key Characteristic: RPPs Are Mutualistic



Key Characteristic: RPPs Are Focused on Problems of Practice, Sites of Possibility

- Problems of practice: Where practitioners struggle to accomplish goals for promoting equity
- Sites of possibility: Seeds that can become new programs and practices that address problems seen by different stakeholders
- These shape the:
  - Research questions that are asked
  - Innovations that are designed and tested

Anatomy of a Problem in a Project within an Emerging Partnership

Improving the Quality of Assessments Used in Inquiry Science

Earlier study in another city found teachers did not use embedded assessments, and those they used were of low quality

US curricula embed few resources to support sensemaking

Increasing Coherence of Supports for Teaching

Commitment to building teacher capacity to implement and assess standards-based curricula that support inquiry

Anatomy of a Problem in a Project within an Emerging Partnership

Improving the Quality of Assessments Used in Inquiry Science

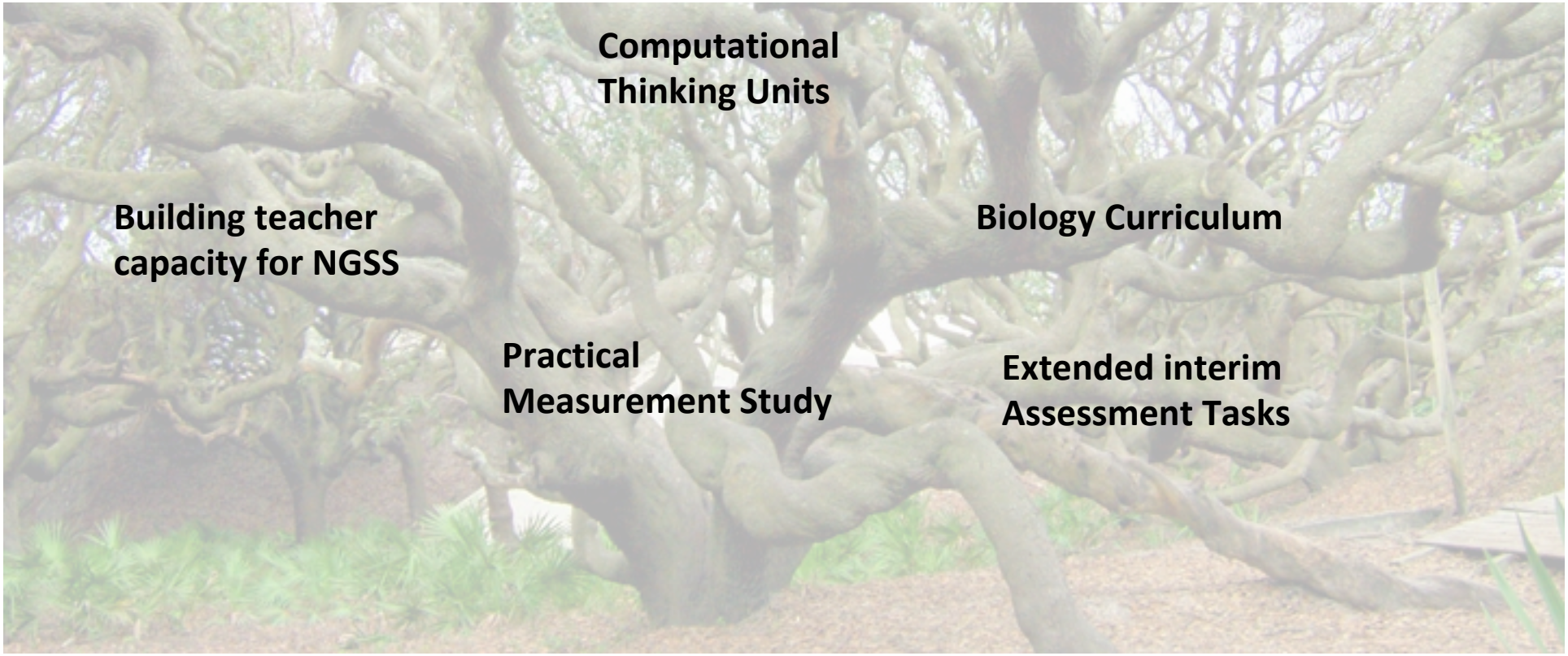
Increasing Coherence of Supports for Teaching

Support teachers in building a culture of public reasoning and argument

Partnerships Tend to Start Small

- A proposal
- A project
- A consulting activity

CU-DPS Partnership Today



Key Characteristic: RPPs Are Long-Term

- Multiple lines of work emerge that are linked to a broader research agenda
- Commitment to continuing to work together becomes more open-ended

Key Characteristic:
RPPs Are Intentionally Organized

- Regular check-ins with key partners
- Longer term strategic planning
- Collaborative design processes
- Data agreements
- Governance

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Partnerships are more than just "projects," they are arrangements that cross traditional organizational boundaries.

Key Characteristic:
RPPs Create Mechanisms to Address Inequity

- Take stock of historical inequities together
- Define “equity” within the partnership
- Structure participation equitably
- Assess equity goals
  - In the partnership
  - In implementation and outcomes

Inquiry Hub Partnership

- A long-term research-practice partnership between researchers at CU Boulder and Denver Public Schools

Math Work: Task Analysis

- *Identifying* tasks that addressed gaps in the existing scope and sequence for the district
  - Significant gaps due to content shifts in CCSS-M
- Rating task qualities as a group
  - Built from approach to professional development developed by Stein, Smith, Henningsen, & Silver (2009)
  - Intended to support shifts in rigor called for in CCSS-M

Teacher Involvement

- Rating the qualities of tasks as a group (adapted from the Stein and colleagues approach)
- Identifying topics for which there were not adequate opportunities to learn presented in the district-adopted textbook (new: fitting to district context)
- Developed and iterated on two rubrics that included dimensions specifically related to equity of opportunity for English Language Learners (new)

Language Rubrics

- Created to address learning needs of emerging bilinguals
- Focus on both the need to engage in rich mathematical discourse and gain access to tasks
- Two rubrics:
  - Language options for expression (opportunities
  - Task language

Rating Schemes and Discussion

iHub

Language: Options for Expression

Where we are | Connecting the spokes | Task Analysis | Task Analysis | Next steps

Level	Number of Raters
Explicit and Highly Varied	1
Explicit and Somewhat Varied	1
Implicit and Limited	2

What evidence from the task supports your rating?
What language from the rubric for options for expression supports your rating?

Infrastructural Components

- Ratings platforms (technological infrastructure)
  - Prototype for task rating
  - Curriculum Customization Service with tasks and ratings of tasks
- Rubrics (representational infrastructure)
  - Focus on dimensions relevant to equitable participation
  - Dimensions held tensions rather than dismissed them
  - Holding fast to cognitive demand independent of teachers' judgments

Co-Design: A Definition

"A highly-facilitated, team-based process in which teachers, researchers, and developers work together in defined roles to design an educational innovation, realize the design in one or more prototypes, and evaluate each prototype's significance for addressing a concrete educational need."

Penuel, Roschelle, & Shechtman, 2007, p. 51

Target of Co-Design

- Project-based science units that are:
  - Anchored in investigations of *phenomena*
  - Engage students in *solving problems* that arise from investigations of phenomena
- Desired Qualities
  - Address a "bundle" of performance expectations from the Next Generation Science Standards
  - Have strong intra-unit coherence
  - Students experience as personally relevant
  - Are deeply digital

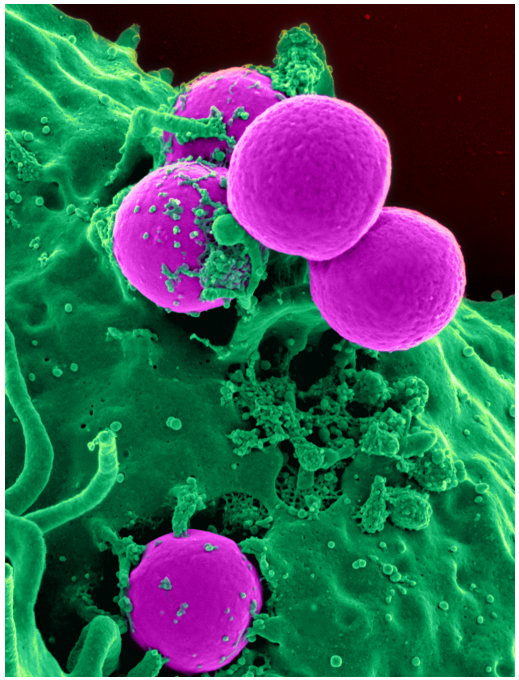
Defining a Design Challenge

- Positions students as designers of a solution to a problem that arises from the anchoring phenomenon
- Connects students in a meaningful way to the community

Design Challenges

Choosing a Tree to Plant

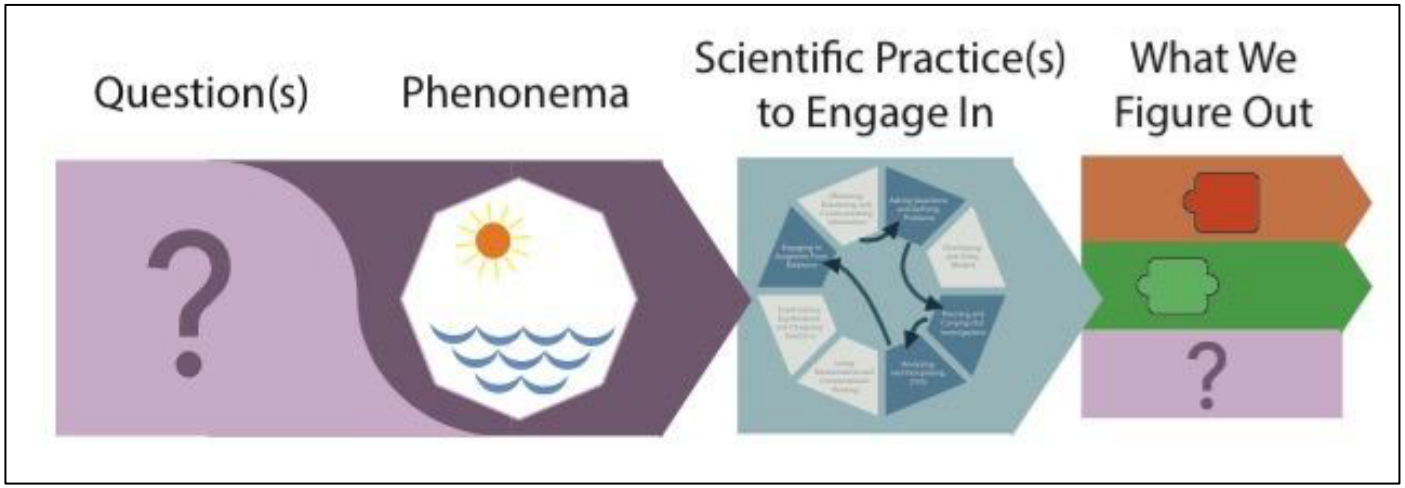
Infographic for Health Clinic



Organize a Café Scientifique

Building a Storyline

We build **storylines** that anticipate sequences of student questions that can drive learning forward.



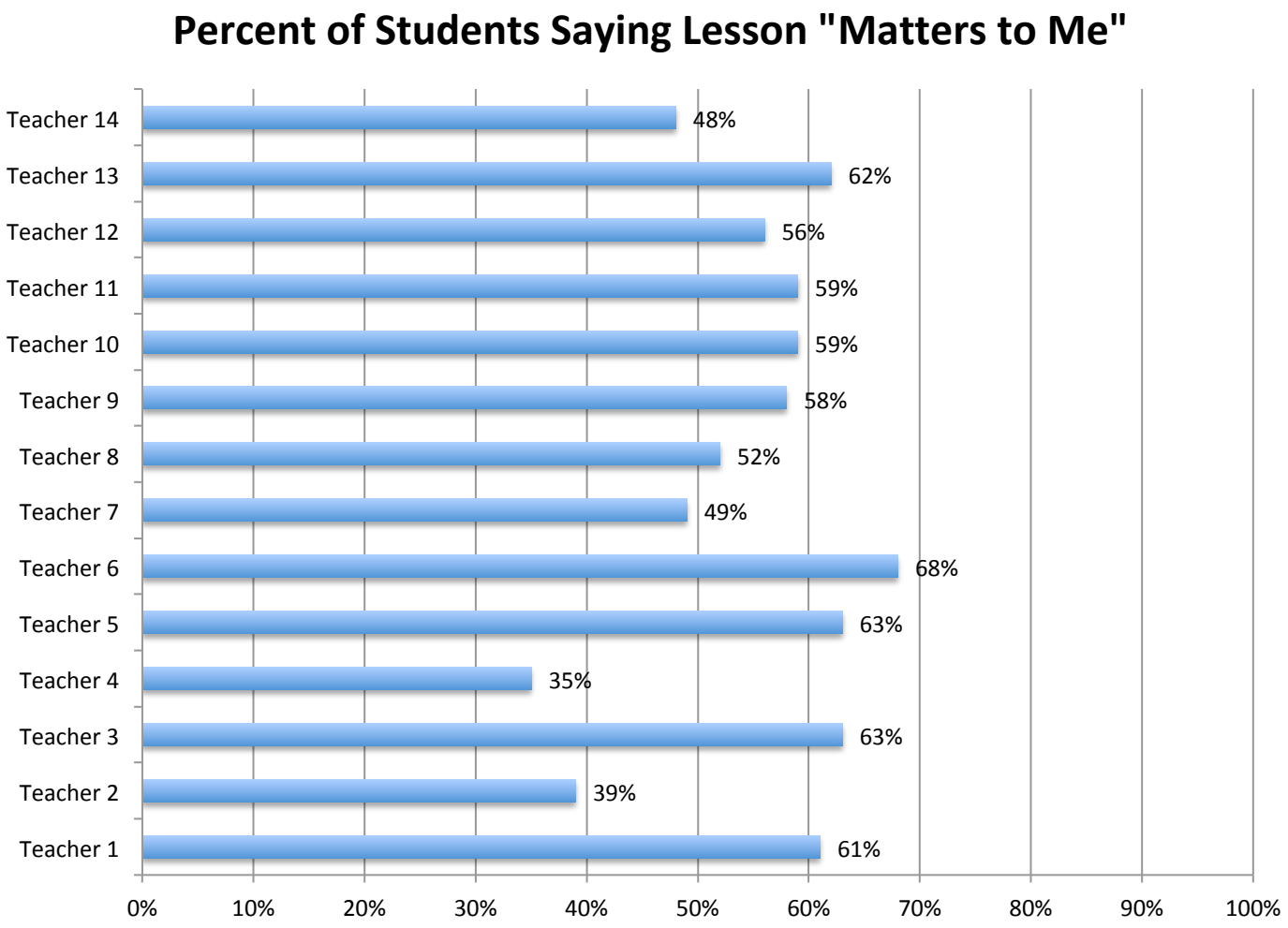
Why Don't Antibiotics Work Like They Used To? (Bend 1 - Bacteria)

This Lesson....What we are doing now: This is the first lesson in the series. Up until this moment, students may never have considered why antibiotics today don't work as well as they used to . In this lesson you will draw upon their experiences with antibiotics and introduce an anchoring event (Addie's case) to which you'll refer throughout the unit. Students will analyze a Frontline video about a pan-resistant bacterial infection case in a little girl, named Addie, Students will ask questions regarding why aren't the antibiotics helping Addie get better. You'll guide them to decide to start a fact timeline with what happened to Addie in chronological order and separate out the differences between species of bacteria "kinds" and strains "types" with each kind.

Lesson Question	Phenomena	Lesson Performance Expectation(s)	What We Figure Out (CCCs & DCIs), *New Questions* and **Next Steps**
L1: How did this little girl (Addie) get so sick? (1 period) *Building toward* ⬇ *NGSS PEs:* *HS-LS4-2 & HS-LS4-4*	A Frontline video clip introduces us to the case of a little girl (Addie) who came into the hospital with a bacterial infection. After several weeks of antibiotic treatment she ends up with life threatening pan-resistant bacteria:. We share our own experiences and related cases with sickness and antibiotics.	**Ask questions** that arise from careful observation of unexpected results, to clarify and seek additional information *about how bacteria caused this little girl (Addie) to become and stay so sick despite receiving antibiotics.*	We have lots of experiences related to bacterial infections and taking antibiotics. For example, some of us have had to take antibiotics from a doctor, some of us have taken other family member's antibiotics. We know family members who had to take antibiotics because they had pneumonia, while others took antibiotics due to a minor infection from a cut. We noticed some important patterns in Addie's case and organized these events into a timeline: • Addie was cut while playing on the playground in 2011. • She came to the hospital sick from an infection caused by one type of bacteria from this cut. • Doctors gave her an antibiotic that worked for awhile, but then stopped working. • She ended up getting another infection from a different type of bacteria while in the hospital. • Doctors then gave her a new antibiotic that worked for awhile, but then it stopped being effective and Addie got sicker. They tried a third antibiotic and Addie started to improve but this antibiotic also stopped being effective and she got worse once again. • They repeated this process trying every antibiotic available to them. We identified some important differences in bacteria that the doctors refer to: • Addie had a type of bacteria in her lungs that was not the type they expected (pan-resistant). • Pan drug-resistant bacteria have "armor" that the antibiotic can't penetrate. • There are different types of bacteria, resistant vs. susceptible (non-resistant). • And there are different kinds of bacteria: Staph (*Staphylococcus*) and *Stenotrophomonas.* We decided it was important to pay attention to the different types and kinds of bacteria and kept track of this information in a summary chart. She seems to have had infections from two different "kinds" of bacteria: (a) *Staphylococcus* and (b) *Stenotrophomonas*. Some of both kinds of bacteria appear to have been killed by antibiotics. However, some of both kinds of bacteria were not killed by those antibiotics. It appears that there are two types of bacteria within each kind of bacteria—those that were resistant to one antibiotic (and lived) and those were not resistant to an antibiotic (and died). *We have a ton of questions! Why is that happening? Can this happen to me? From where can you get bacteria? How can a substance that helps wipe out the bacteria work for a bit, then stop working? How do antibiotics even work?* **After making a record of our questions, we identify some next steps to pursue. Because we are really concerned about whether this can happen to us, we want to know if cases like Addie's are common, or if this is a pretty isolated case.**

These materials were developed with funding through a grant from the Gordon and Betty Moore Foundation to Northwestern University and the University of Colorado Boulder.

Measures of Student Experience



Infrastructural Components

- A highly facilitated co-design process
  - Storyline as a tool for promoting coherence from student perspective
  - Includes opportunities for teachers to shape the process and the content
  - Student voice: Selecting an anchor for units in project is informed by a student interest survey
- A simple, Google Forms-based mechanism for monitoring equity in student experience within and across classrooms

Infrastructural Components (Planning Stages)

- New interface for our student-facing measures to support teacher customization and analysis of data
- Extending partnership to include a youth organization:
  - To expand youth voice in selection of engineering design challenges
  - To support teachers in developing more attention to developing constructive relationships with students

Promoting Coherence

- For teachers, it is not enough to build a new curriculum or program that addresses standards.
  - They need professional development aligned to goals of curriculum.
  - Assessments used by the district need to focus on goals of the curriculum.
- An RPP must engage in work to identify parts of the instructional guidance infrastructure to re-design and work to enhance vertical and horizontal coherence.

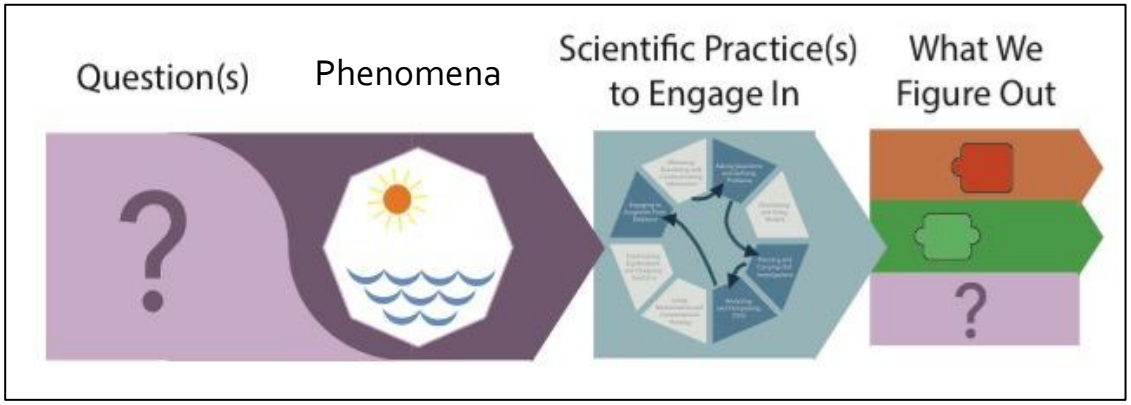
Building a Coherent and Equitable System in Denver Public Schools

Driving Questions Board

Exit Tickets: What Questions Should We Take Up Tomorrow

Phenomenon Interest Survey

Consensus Building Discussions



Eliciting Related Phenomena

Model Gallery Walks

Exit Tickets: What Did We Figure Out Today?

Building a Model of the Phenomenon

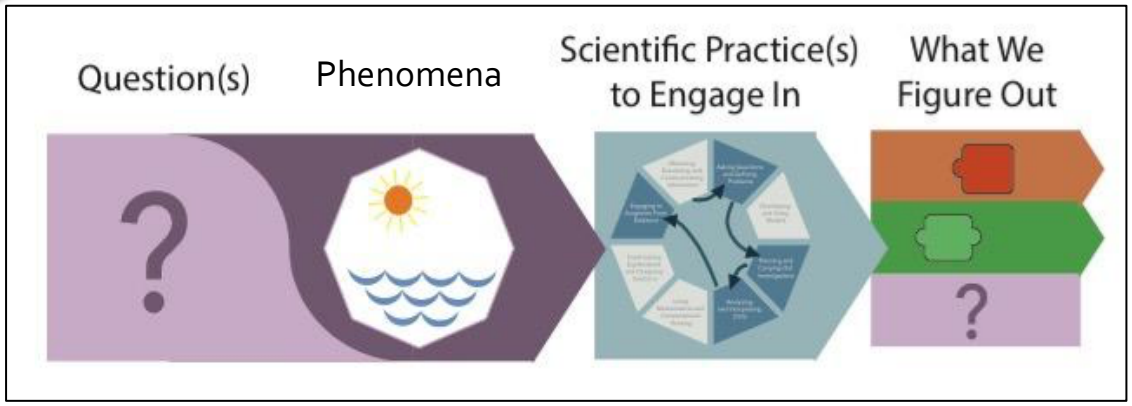
Designing a Solution to a Problem

New, phenomenon-based biology units embed assessments to elicit interests, related experiences, and 3D learning performances.

Building a Coherent and Equitable System in Denver Public Schools

SLO Rubrics:
Analyzing Growth in Modeling Practice

Principal Observation Protocol:
What are you figuring out today?



3D
Transfer
Tasks

Re-designed infrastructure components aim to provide consistent guidance to teachers.

Professional Development Supports:
Analyzing and Grading Student Work, Using Exit Ticket Data

Infrastructural Components

- New interim assessments and process for developing them
  - New grant: Focused on building cadre of assessment developers using a set of tools and PD the CU team has developed collaboratively with input from district and state leaders across the US
- Walkthrough protocol
- Classroom assessments that can be graded in ways that meet teachers' expectations and those of their principals

The Challenges to the Work

- Synchrony
- Evidence gathering and use
- Resources for addressing emergent needs
- Finding time to share and learn from other partnerships
- Concerns about interest convergence (Bell)

The Infrastructure Partnerships Need

- Funding for more than just innovation…but infrastructure for partnerships and addressing emergent needs
- Networks for sharing across partnerships
- Educational change in:
  - Preparation of doctoral students in both research and education leadership
  - Incentives in the academy

What's New

- Possibilities for learning from partnership work
- Recognition of the multidimensionality of challenges related to equity
- The larger sociopolitical context