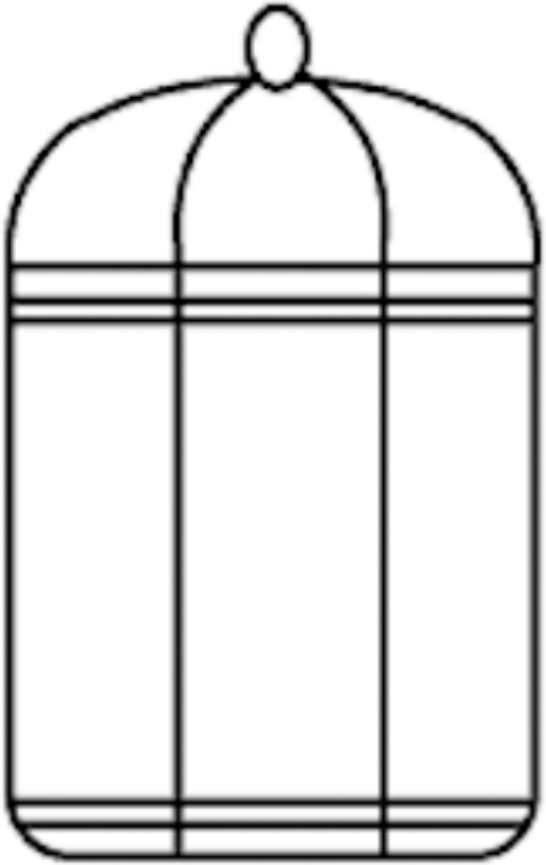
Stare at one of the birds for 30 seconds and then stare at the empty cage.



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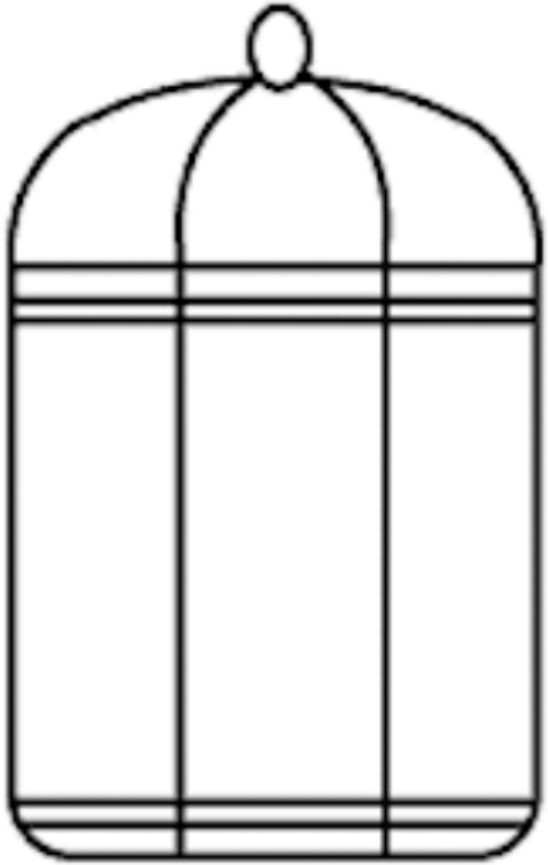
Teacher Professional Development in the Age of NGSS

Sara Heredia, Exploratorium*; Bethany Sjoberg,*Highline Public Schools*; Jessica Thompson,* University of Washington

STEM Smart workshops are funded by the National Science Foundation grant #1449550. Any opinions, findings, and conclusions or recommendations at this event or in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Agenda

- Bird in Cage Activity
- Design principles for science teacher learning
- Two models of professional learning
  - Exploratorium Teacher Institute
  - University of Washington
- Reflections/discussion



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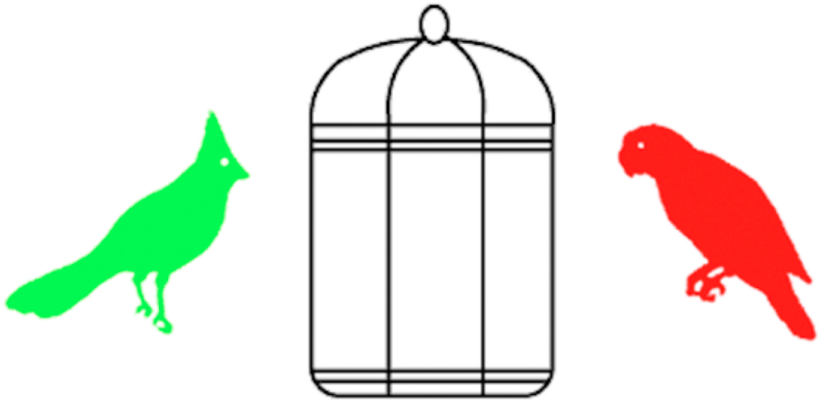
What is going on?

1. Pick a set of observations about the bird in the cage and explain why there is variation.



2. What evidence do you need to support your explanation?

3. What would you like to try next to gather some of that evidence for your explanation?

HS-LS1-2.Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Disciplinary Core Idea(s)

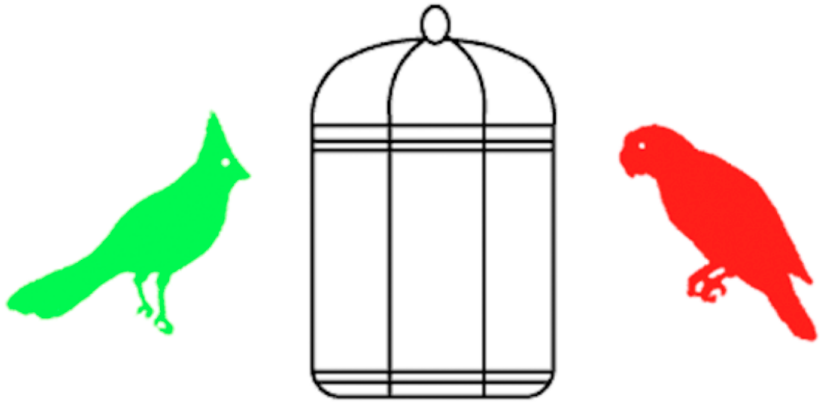
- LS1: From cells to organisms: Structures and processes

Science Practices

- Constructing explanations
- Planning investigations

Crosscutting Concept(s)

- System and system models
- Structure and function



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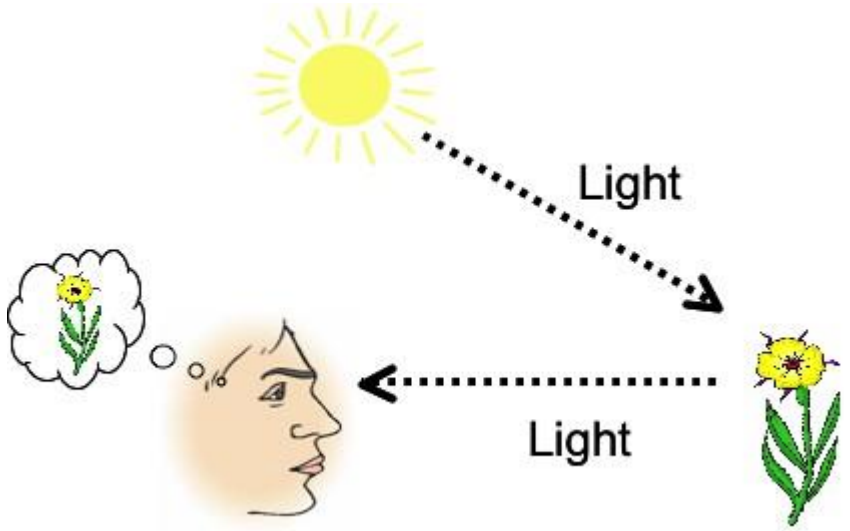
How is this different?

How this activity is different from how you learned about the structure and function of the eye and how humans see?



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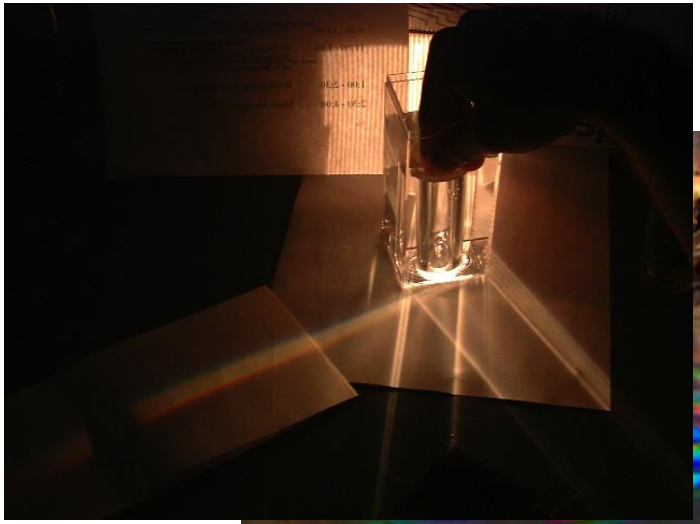
Design principles to support teacher learning

- Time for teacher sensemaking
  - as a science learner
  - as a science teacher
- Time for planning collaboratively for implementation
- Follow-up to support implementation
- Teachers involved in creating resources, common tools, practices

Exploratorium Teacher Institute



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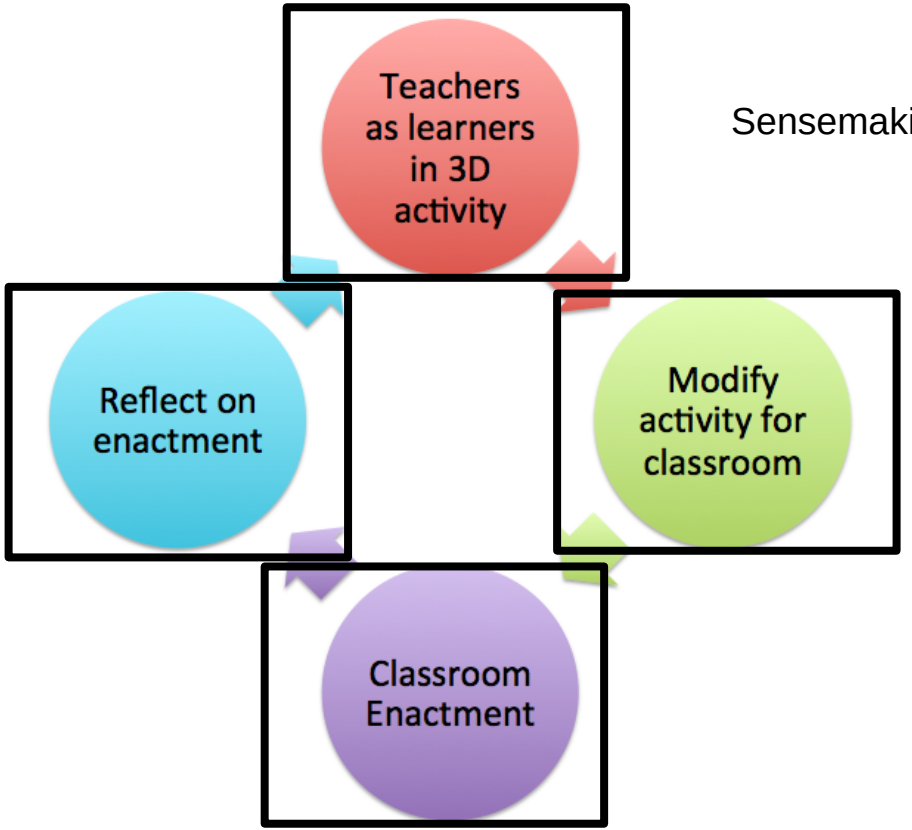
Teacher development of Next Generation Science *Snacks*



Sensemaking as science learner

Sensemaking as science teacher

Collaborative development

This material is based upon work supported by the National Science Foundation (NSF) under grant DRL-1503153.

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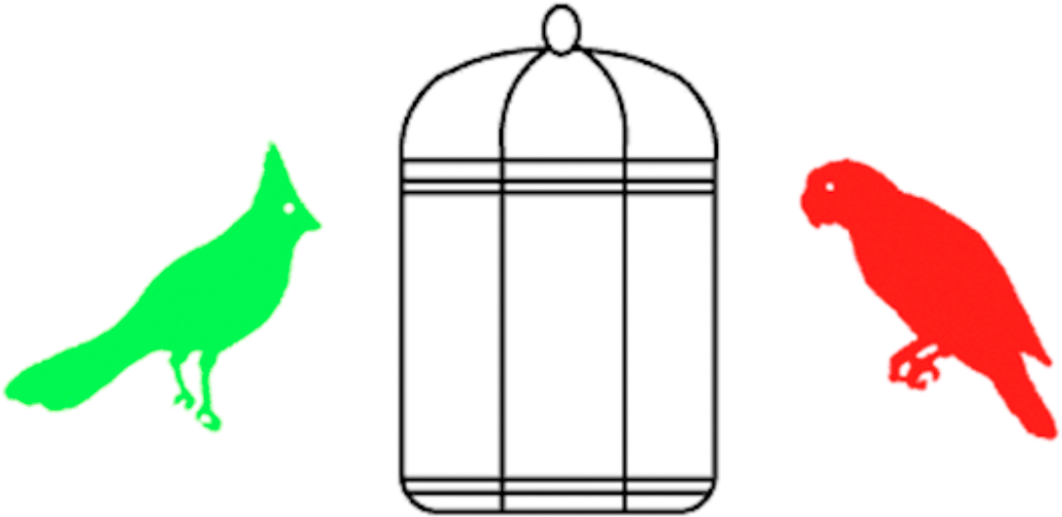
NGSS*nacks* Planning Tool



Write a well-developed explanation, argument or model that describes the phenomena represented with snack.

What ideas/concepts will students come up with in this activity? Challenging ideas or common intuitive ideas

What will students know and understand after they've completed the activity? Where will we go next?

What materials and resources might students use to resolve confusion or uncertainty about what's going on? [focus on engaging in science practices]

This material is based upon work supported by the National Science Foundation (NSF) under grant DRL-1503153.

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teacher institute

Search Snacks

Search

Science Snacks

Hungry for fresh, exciting science content based in mind-blowing natural phenomena? Try our Science Snacks: hands-on, teacher-tested activities you can do at home or in your classroom using cheap, readily available materials. Satisfy your curiosity without ever getting full. Learn more.

Snacks A-Z
Search for Snacks alphabetically.

Snacks by Subject
Search for Snacks based on subject or content area.

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Building NGSS Networked Improvement Communities

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University of Washington

Bethany Sjoberg
Highline Public Schools

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College of Education

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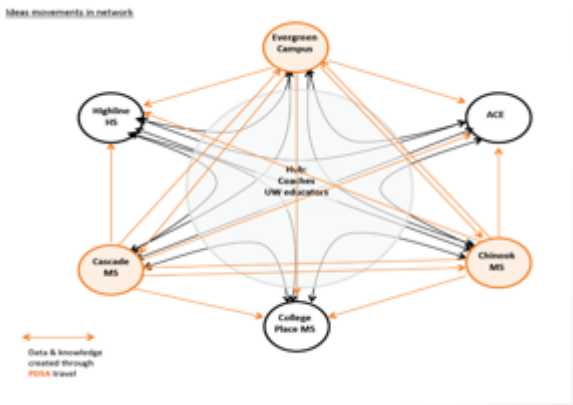
Today

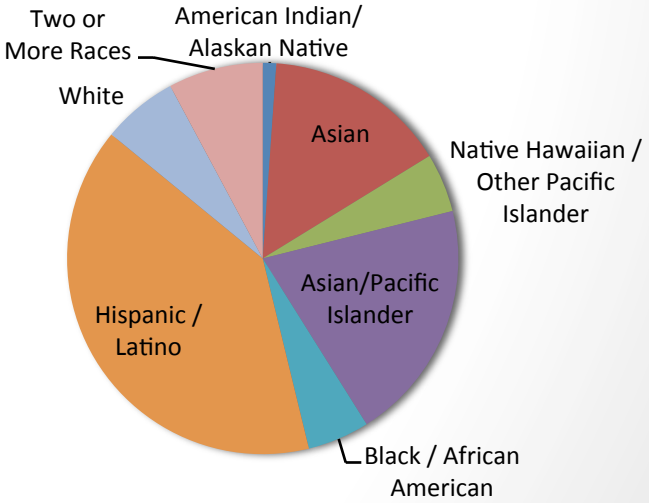
Key Ideas

1) Professional development can aim to adapt and improve teaching practice (not just adopt and disseminate)
2) Networks can support the improvement of practice over time
3) Such networks need a common vision, and set of practices and tools of ambitious science teaching practice
4) Need to design for job-embedded professional development



Our Local School Context

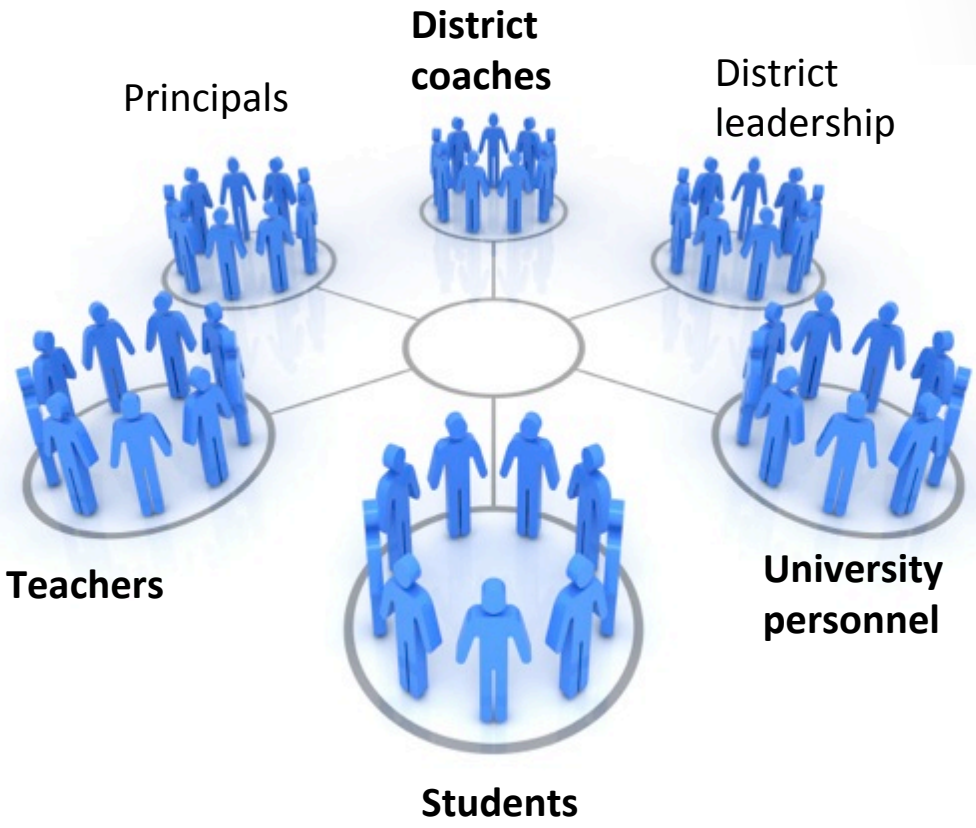
Student Cultural and Linguistic Diversity



Improving teaching as well as teachers

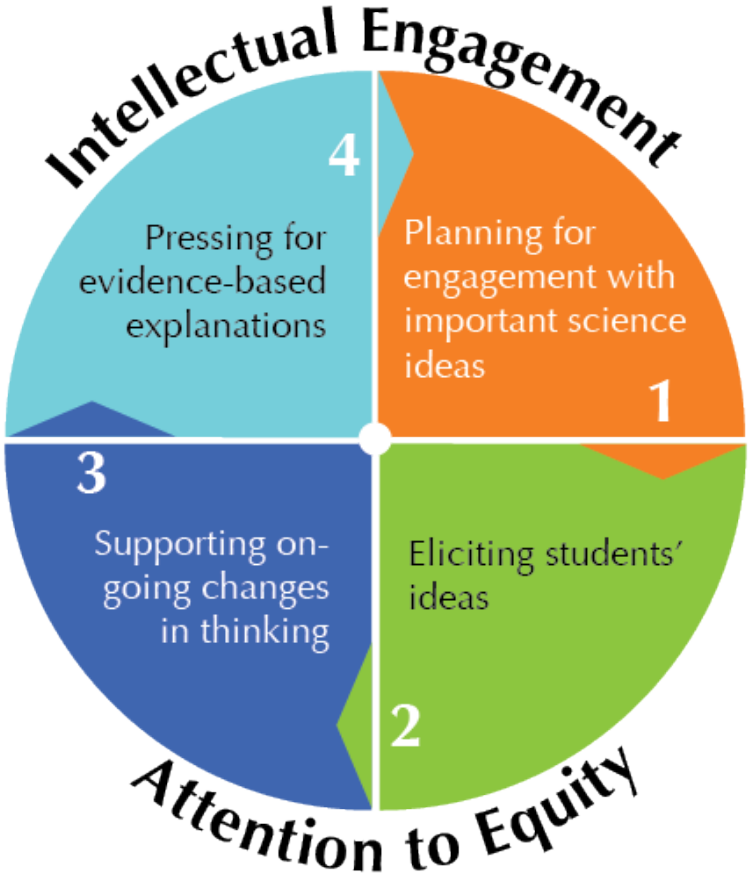
Networked Improvement Communities:

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

Starting with a common set of evidence-based teaching practices



NETWORK GOALS:

- All students have improved written and spoken scientific models, explanations & arguments.
- Improve tools that support ambitious and equitable teaching—for all students and EL students in particular.

http://ambitiousscienceteaching.org/

GOAL:

Improve all students' written and spoken science explanations, arguments & models

PRIMARY DRIVERS:

- Making the language of science explicit
- Equitable talk for how/why explanations
- Using evidence to construct and revise explanations
- Revising models with evidence

SECONDARY (ACTIONABLE) DRIVERS:

- Using language functions as lens for reading, writing, and modeling
  ACE
- Structured talk for how/why reasoning
  5th/6th STEM Academy
  Cascade MS
  College Place MS
  Pacific MS
  Renton HS?
- Revising lists of student generated hypotheses with evidence
- Peer feedback to deepen written explanations
  Chinook MS
  Evergreen Campus
  Highline HS
- Sequenced share-out of models
  ACE/Global
  Mt. Ranier

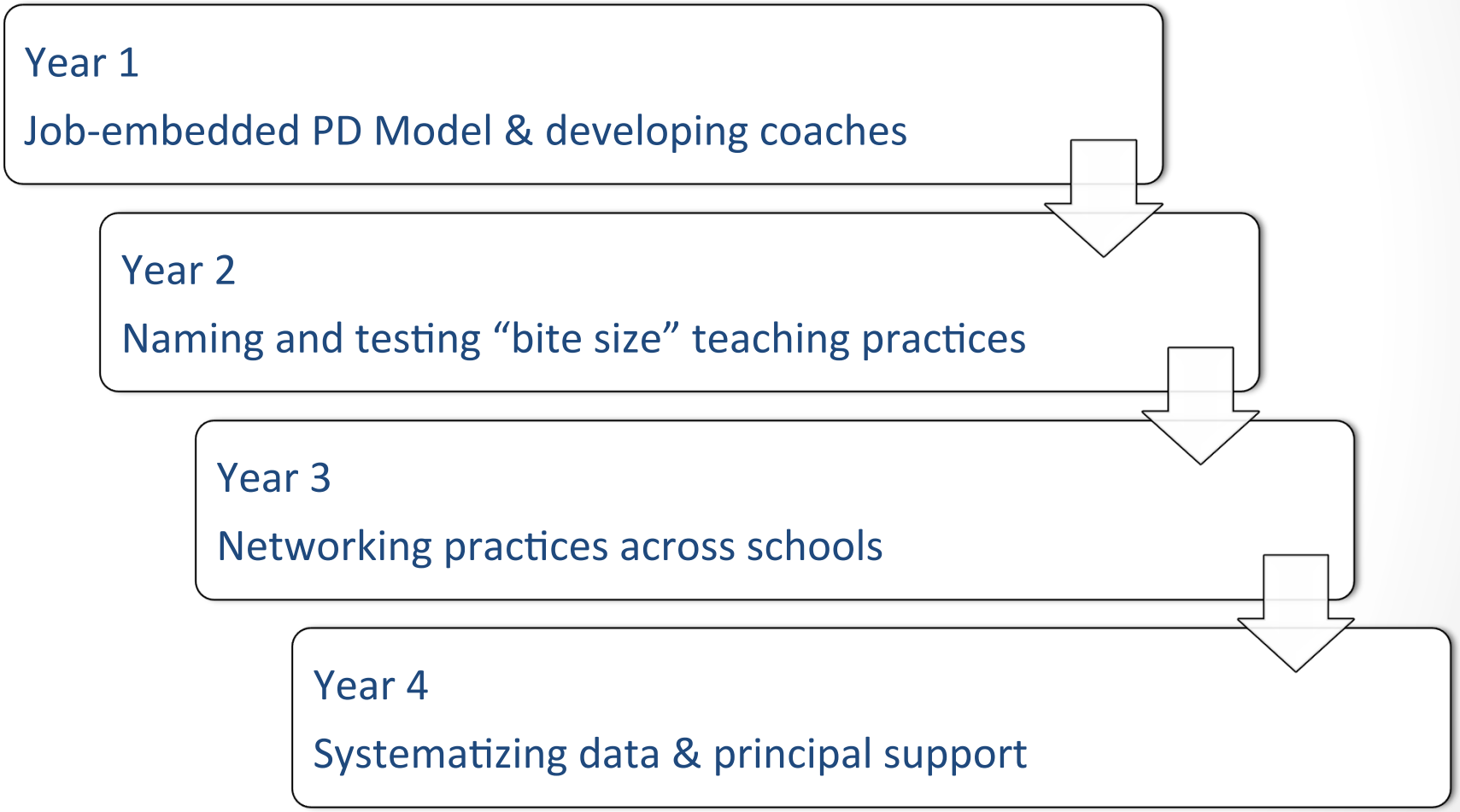
* Change package developed

Science teaching practice: Peer feedback to deepen written explanations

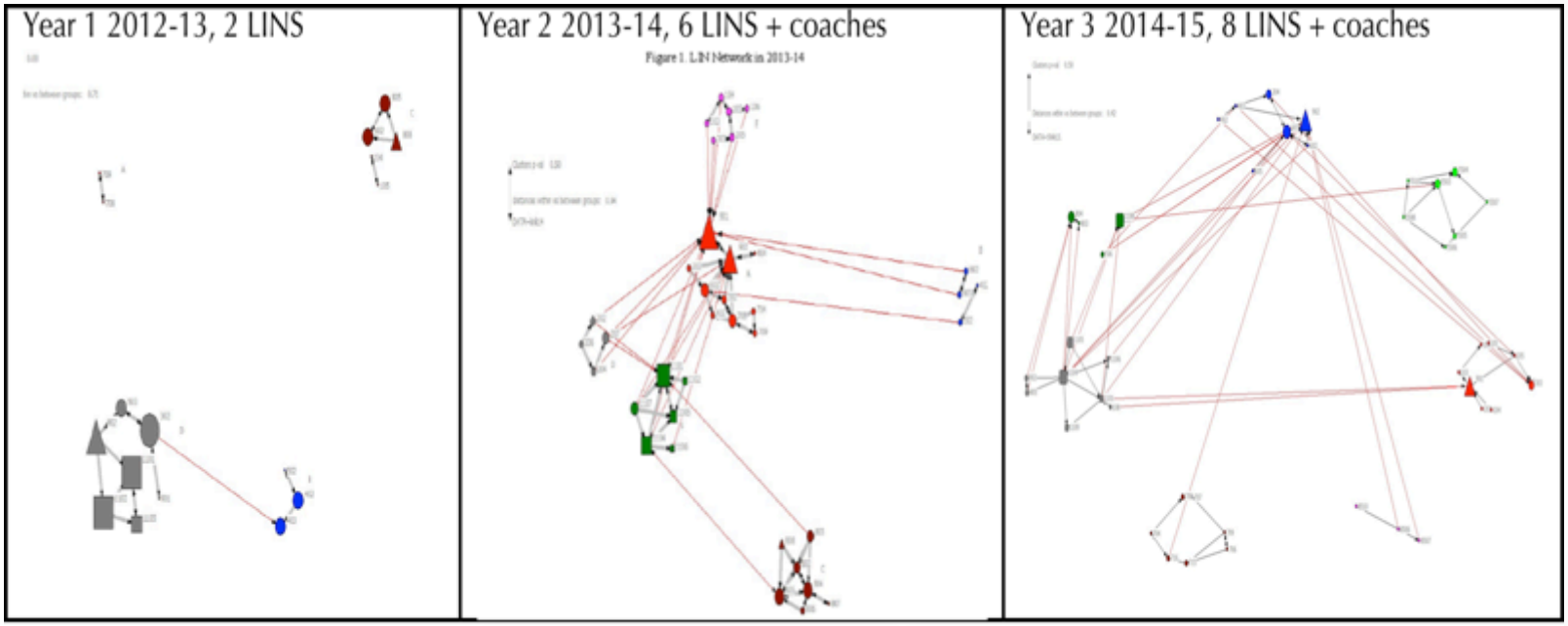
Markers of Ambitious Teaching

	Ambitious Teaching	Status Quo Teaching
TASK	Begins with a complex and content-rich scenario and high expectations for student learning Activities are designed in service of learning about big ideas and supporting students in revising their ideas over time	"Basics first" approach or Activity-Mania Inquiry with focus on individual activities
TALK	Purposeful talk with elaborating, questioning, and reorganizing of ideas as the goal; students' ideas are uncompromisingly treated as intellectual resources	Talk aimed at a "right answer", dominated by teacher-talk
TOOLS	Tools that scaffold student reasoning	Materials that describe "how to proceed"

Systems thinking: Developing Networks that Improve Practice



Social Networking Analysis

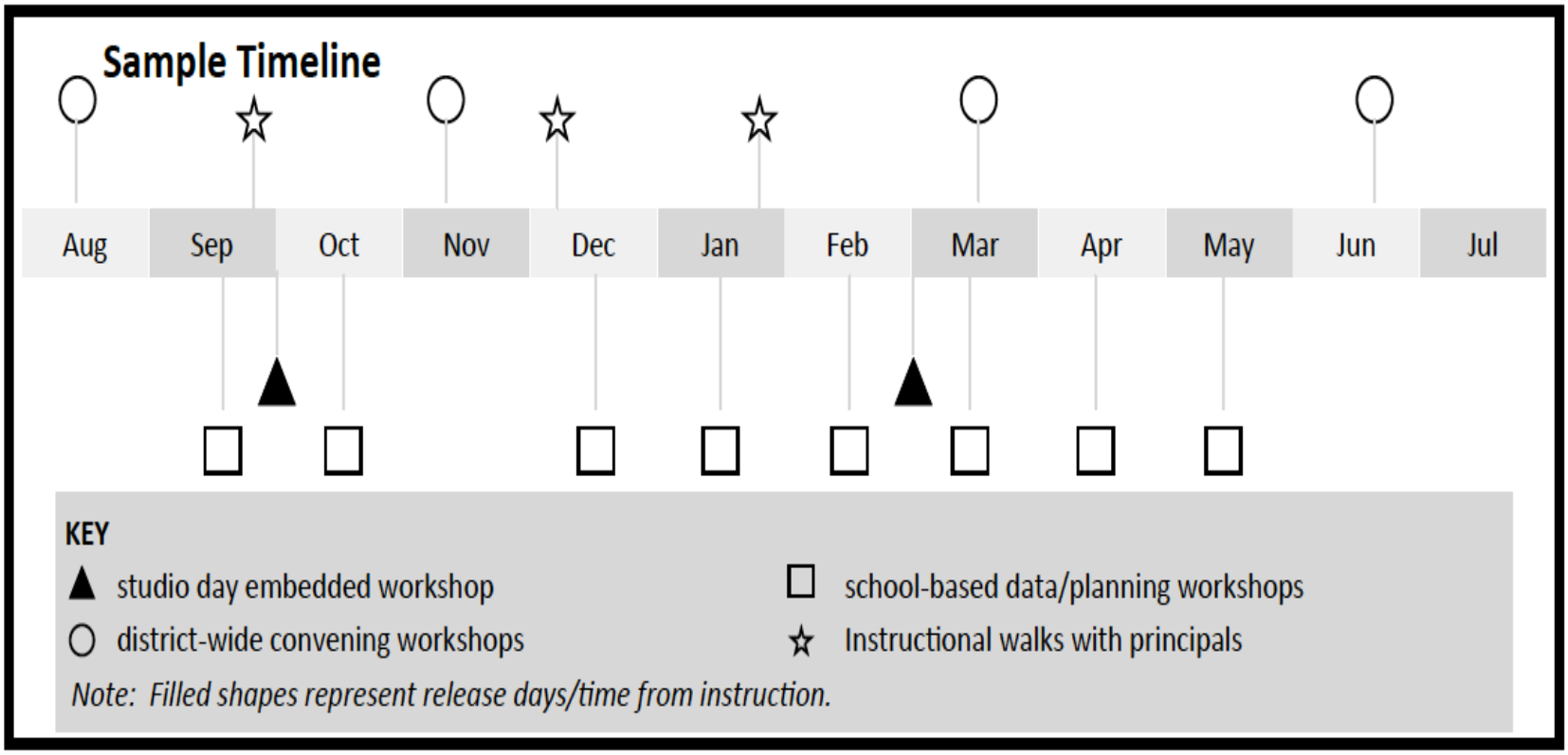


Markers of Networked Professional Development

Status Quo PD Adopt & Disseminate	Networked Improvement Communities Adapt & Improve
Pull out of classrooms Traditional roles with an "ivory tower"	Job-embedded- in classrooms Blurring roles
Focus on what to teach (walk-throughs of lessons)	Focus on student thinking as basis of revision to teaching
Stand-alone "teacher proof" tools	Tools that stabilize ambitious practices
Potpourri learning: 3 days/year	Accelerated learning: 90-day inquiry cycles into specific practice & principled adaptations
Individual's tinkering	Teams engaged in small tests of small changes & shared with the network

Social structures supporting the improvement of practice

Peer feedback to deepen written explanations

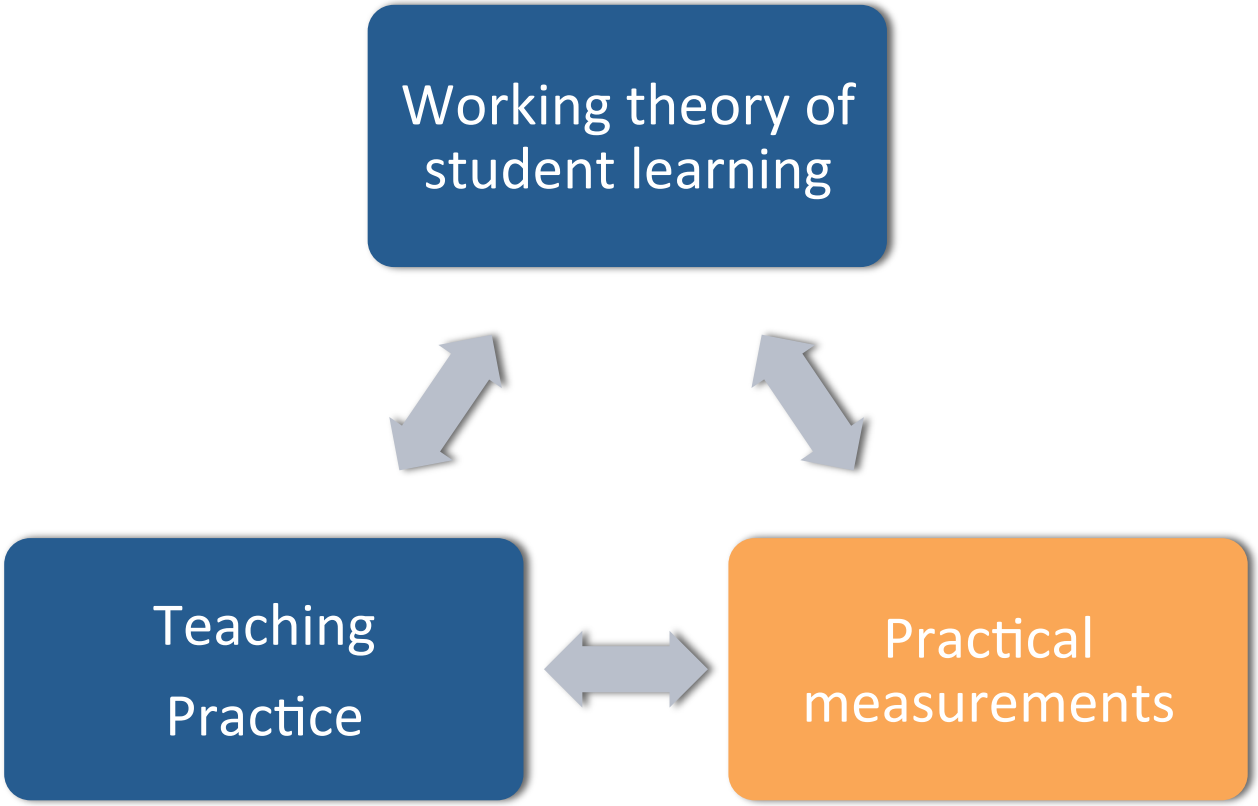


"Studio Day"
Learning in and from practice

All-day job-embedded professional development where teachers collaborate to give real-time feedback in an authentic teaching & learning space.

(Ball & Cohen, 1999; Borko, 2004; Grossman et al., 2009; Lampart 2009)

Learning Loops: What gets tested and shared in and across schools?



Bryk, Gomez, Gunrow, LeMahieu, 2015

NIC measurements

- Outcome: classroom observation of science and ELL practices, student explanations & use of evidence
- Process data: studio day data, SNA data, teacher self reports
- Process step measure: features of the science teaching practice is being used
- Learning cycle measures: Temporary data for small tests of small changes for science teams

How can we better support EL students in science and learn from one another's attempts? How can we leverage planning?

Types of Activities	2014-2015		2013-2014		2012-2013	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Overall	509.36	351.53	366.15	433.79	358.33	436.69
Sharing existing materials	86.24	83.77	54.95	66.00	56.33	68.17
Co-creating instructional materials	91.56	75.27	55.50	65.61	52.17	69.10
Understanding science content	65.29	84.81	49.65	73.38	34.75	49.80
Discussing student learning	84.75	59.10	60.85	74.54	53.17	87.16
Understanding learning and teaching	70.45	60.67	57.95	72.65	52.33	69.99
Analyzing examples of student work	41.55	41.02	29.10	48.17	32.67	58.31
Co-teaching	11.38	13.93	9.35	30.12	28.42	61.14
Providing feedback	33.45	51.19	23.85	41.63	18.83	39.12
Improving instruction for ELL	24.69	33.96	24.95	40.52	29.67	50.04

EVERGREEN DATA SNAP TOOL

Name Nicole Flynn
Date 4/14/14
Class Period 3rd Period

1) Science lesson topic: Phenomenon: Ocean Acidification Lesson: Rearrangement of molecules

2) Who tried the practice?
- ● Teacher
- ○ Teacher + Coach

3) How often have students used A/B talk in your class?
- ○ This is the first time
- ○ They have tried it 1-2 times before
- ○ They have tried it 3-5 times before
- ○ This is done regularly in my class 1-2x/week
- ○ This is done regularly in my class 3-5x/week
- ● We practice A/B talk daily

4) **PLAN** your A/B question(s):

Based on your hypothesis what are you saying is happening to these 2 molecules (H_2O & CO_2)

5) Below are the drivers for supporting ambitious and equitable instruction in small group interactions that you generated from studios. Bubble all that applied to this lesson:

What-how-why: Give them the "what"
- ● as a part of the launch, build in what level observation then as a why Give models of CO_2 & H_2O
- ○ have students compare and contrast data and talk about what happens
- ○ as a part of tools/ models start with what questions and provide visuals of the "what"
- ○ provide modeling keys
- ○ students have readings/videos that help them develop a "targeted why"
- ○ have targeted questions about the why
- ○ ask 3 rounds of structured "why" questions
- ○ remind students about resources (journal etc.)

OTHER:

Equity: Structured Turn & Talk- A/B partner talk
- ● Directions on how to do A/B talk were shared with students
- ● The directions were specific to this lesson
- ○ Students were given feedback on HOW they engaged in the talk
- ○ Have students engage with their partner's ideas "listening for understanding"
- ○ Be explicit about how much students are talking – engage them in self-monitoring/ give an exit card about how the AB talk supported their science reasoning
- ● Provide private think time prior to talk
- ○ share out structure after structured talk

OTHER:

Small Group Discourse: Accountability in Modeling
- ○ have all students participate in written forms of models (using color pencils/pens)
- ○ have students use role cards
- ○ Students were given a "model scaffold" to work on together
- ○ Students had an explanation checklist

OTHER:

EL supports- Empowering ELs to share what they know & develop fluency with academic talk
- ● EL students are identified
- ○ use sentence stems for EL students
- ○ differentiate questions for different levels of EL students
- ● intentionally pair students to support use of language and language development

OTHER:

Learning Target: I determine how particles might Δ in chemical reac.

Know by end of class: Rearrange atoms in H_2O & CO_2 → H_2CO_3

atoms don't Δ | bonds ... | talk about bonds ... bonds break & reform

DO DURING CLASS

6) Choose 2-4 underserved students (EL or not) and listen in on their conversation and/or look at their student work. List evidence of what / how / why level engagement for each student (use initials):

	What Student describes what happened. Student describes, summarizes, or restates a pattern or trend in data without making a connection to any unobservable/ theoretical components.	How Student describes how or partial why something happened. Student addresses unobservable/ theoretical components tangentially.	Why Student explains why something happened. Student can trace a causal story for why a phenomenon occurred or ask questions at this level. Student uses important science ideas that have unobservable/theoretical components to explain observable events
Student 1: Victor ○ intermediate EL ○ advanced EL ○ Not EL	"	"atoms break/split up, creating new bonds to create H_2CO_3"	"they form a new molecule H_2CO_3... when they come together they break apart & create new bonds so they make a new molecule"
Student 2: Miguel ● intermediate EL ○ advanced EL ○ Not EL	"atoms of same kind" "type"	"becoming a diff kind of molecule" "form new bonds"	"double bond... have to separate one bond so that the other atom... combine"
Student 3: ○ intermediate EL ○ advanced EL ○ Not EL			
Student 4: ○ intermediate EL ○ advanced EL ○ Not EL			

STUDY AFTER CLASS

7) What parts of the practice seemed to work for these students? What did not?

Victor built in someone else's idea
- structured talk- before share out
- sentence stem & prompt from teacher
- public record of (working) shared ideas
- directions for share out
- ppt to think about how to build

8) Did you learn anything that would help address our outstanding questions? What are other outstanding questions you have? (E.g. the following questions arose during SD #4)
- ○ We were wondering if we should start a new learning structure like the structured talk at the "what" level to prevent too much confusion about the process (vs. content).

all of these ideas

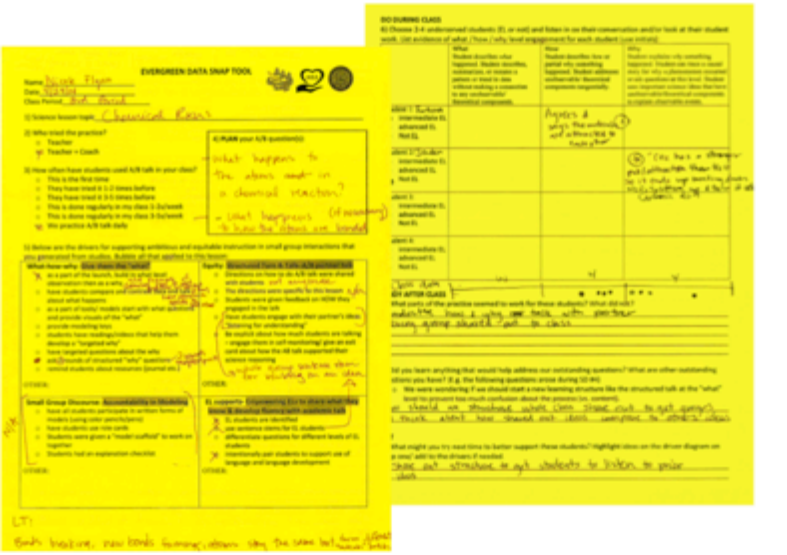
ACT

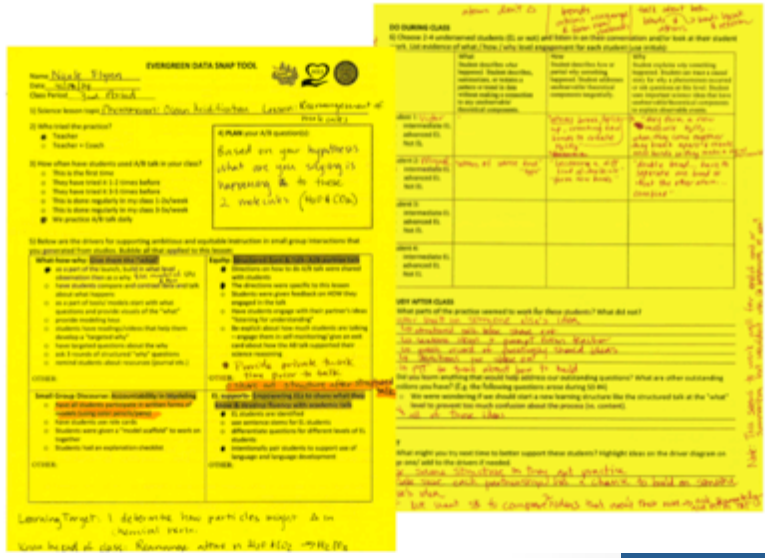
9) What might you try next time to better support these students? Highlight ideas on the driver diagram on page one/ add to the drivers if needed.

- Use same structure so they get practice
- Make sure each partnership has a chance to build on someone else's idea
- If we want SS to compare 2 ideas that aren't their own → ask specifically for ...

Note: This seems to work well for ... but wouldn't ...

PDSA/Practice

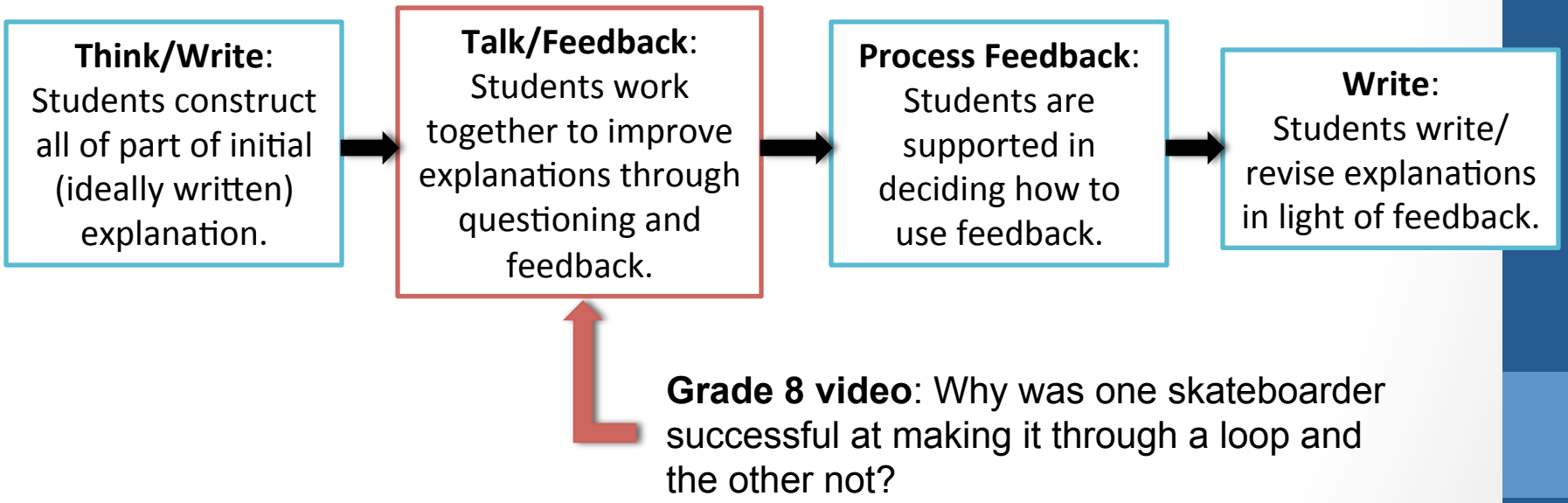




Peer feedback to deepen written explanations

Problem of Practice: Students talk deeply about scientific phenomena, but that talk often does not translate into writing. How can we capitalize on talk or feedback to help them deepen their *writing*?

Simplified Practice Flow:

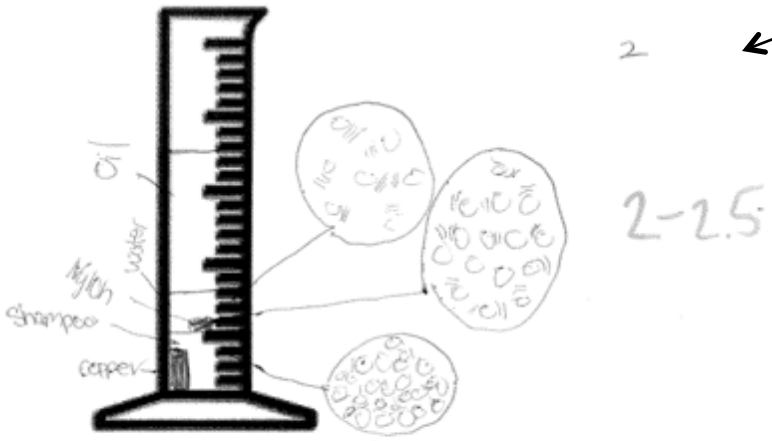


Question: Why did the nylon stopper stay in between the shampoo and the water in the density column?

Include a zoom-in of:
- ☐ the nylon stopper
- ☐ the shampoo
- ☐ the water

Before Talk

2



2-2.5

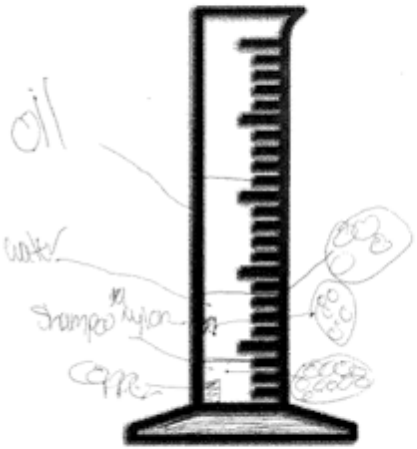
The nylon stopper stayed between the shampoo and water because ~~they~~ density is right between the shampoo and water

After Talk

AFTER DISCUSSION:

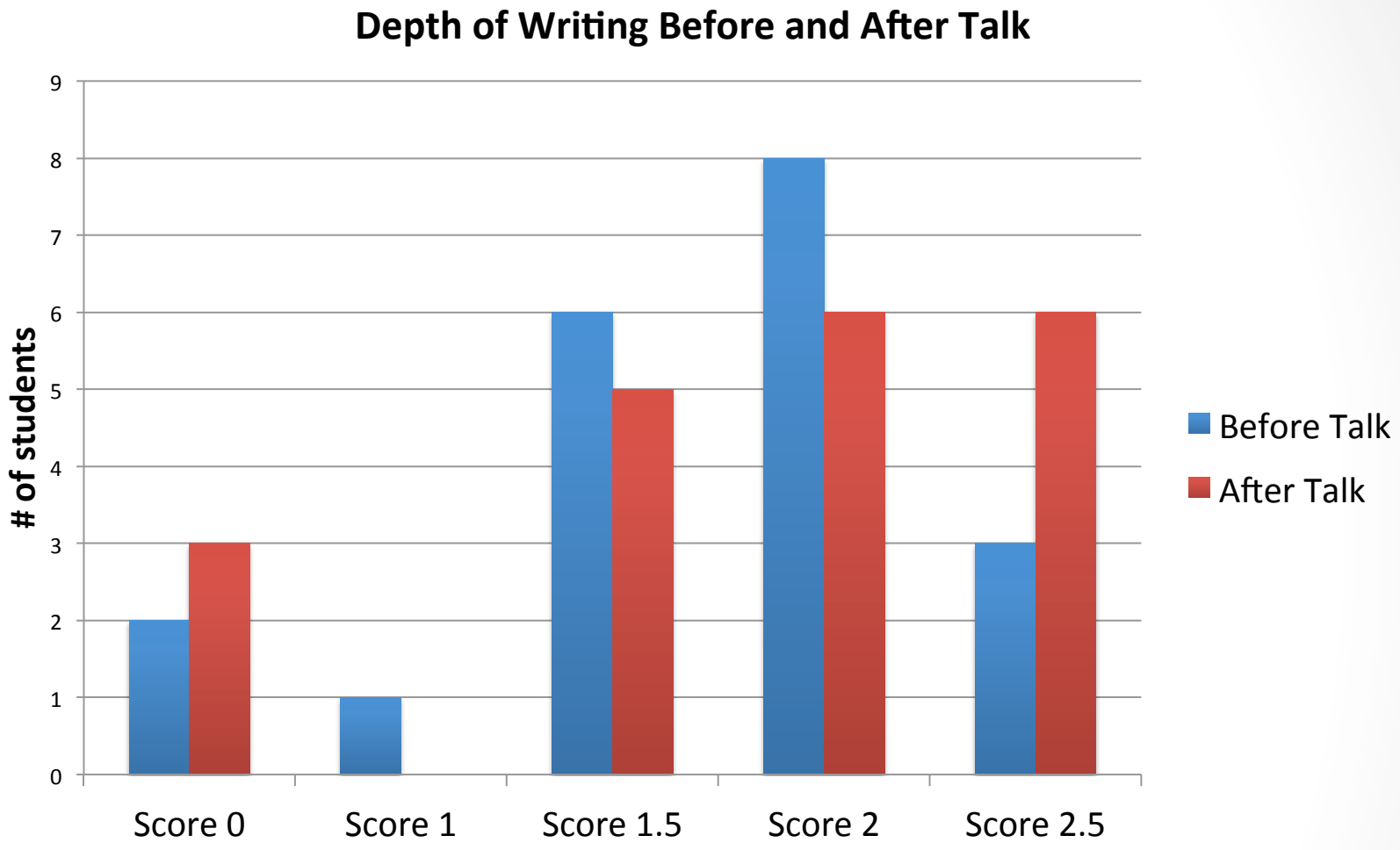
Question: Why did the nylon stopper stay in between the shampoo and the water in the density column?

Include a zoom-in of:
- ☐ the nylon stopper
- ☐ the shampoo
- ☐ the water

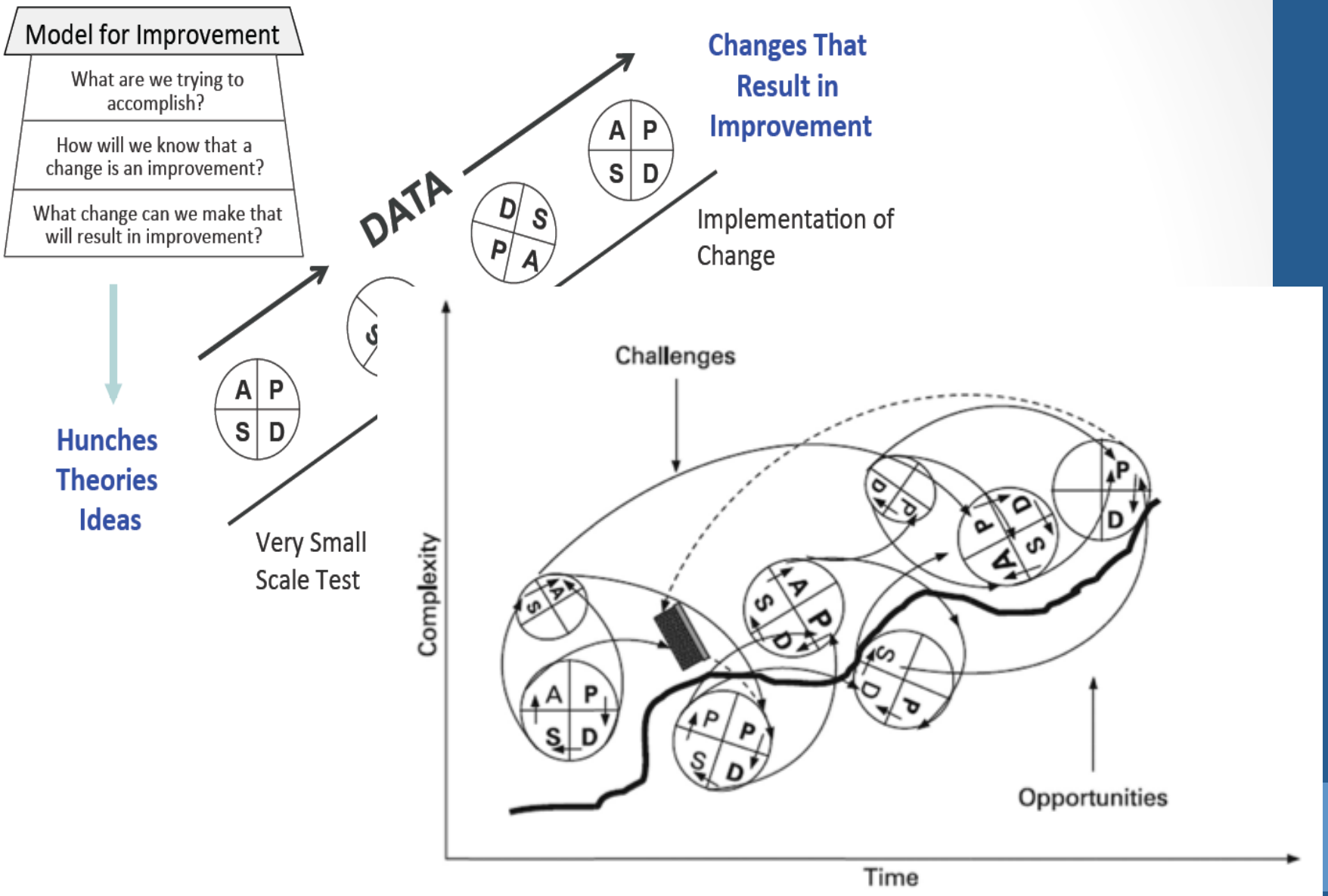


2

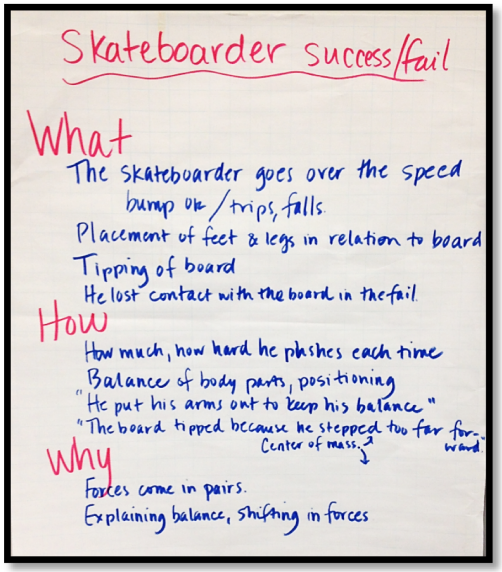
The nylon stopper stayed between the water and shampoo because the molecules were more packed in the shampoo so the nylon couldn't go below that and the water didn't go so it could go down

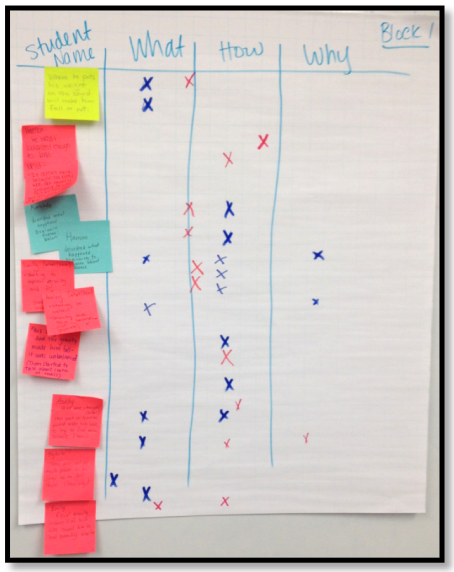


*From 1 class of 20 students


Model for Improvement
What are we trying to accomplish?
How will we know that a change is an improvement?
What change can we make that will result in improvement?
Hunches
Theories
Ideas
Very Small Scale Test
DATA
Implementation of Change
Changes That Result in Improvement
A P S D
D S P A
Challenges
Complexity
Opportunities
Time

Develop “change packages” that investigate how the practices work, under which conditions and for whom





When you engaged in structured talk with a partner, w

- [x] I shared my idea
- [x] I listened to my partner's idea
- [x] I agreed with my partner's idea
- [x] I added on to my partner's idea
- [ ] I disagreed with my partner's idea
- [x] I used scientific evidence to support my idea
- [ ] I asked a clarifying question
- [x] My partner and I looked for similarities and differences in our ideas
- [x] I used a sentence stem to explain my idea
- [ ] Other _____

What did you and your partner talk about? Be specific.

My partner and I talked about our own thinking abo
r hypothesis on our lab and what are the optimal ranges of an enzy

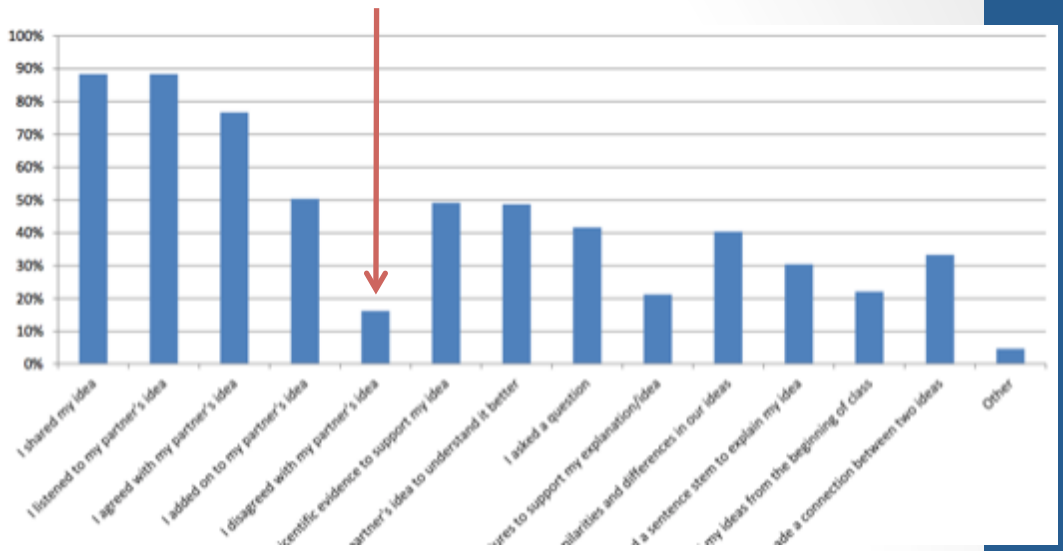
What went well in your discussion? What could have gone better?

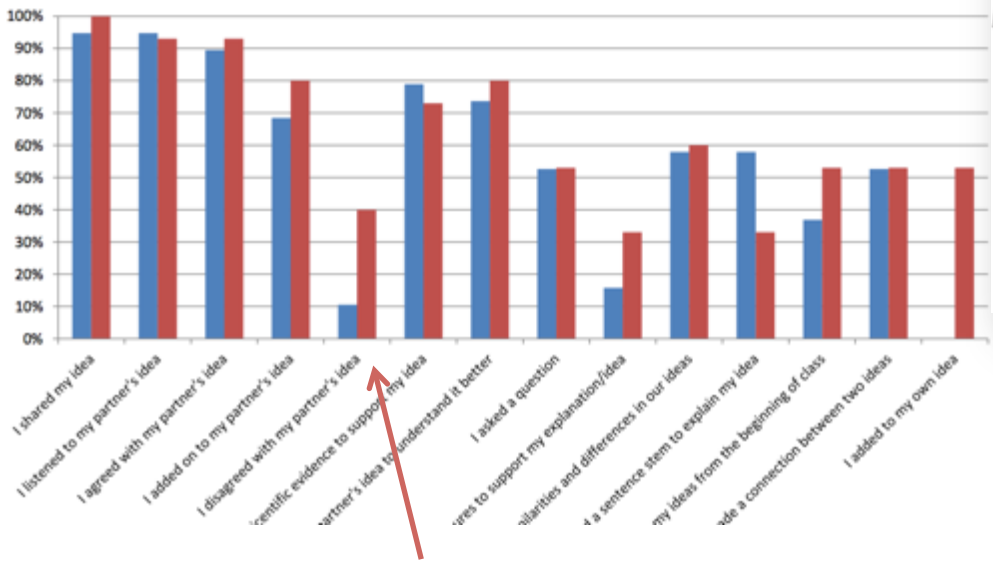
erything went well in my discussion because we both listened
h other and was able to build off our ideas.

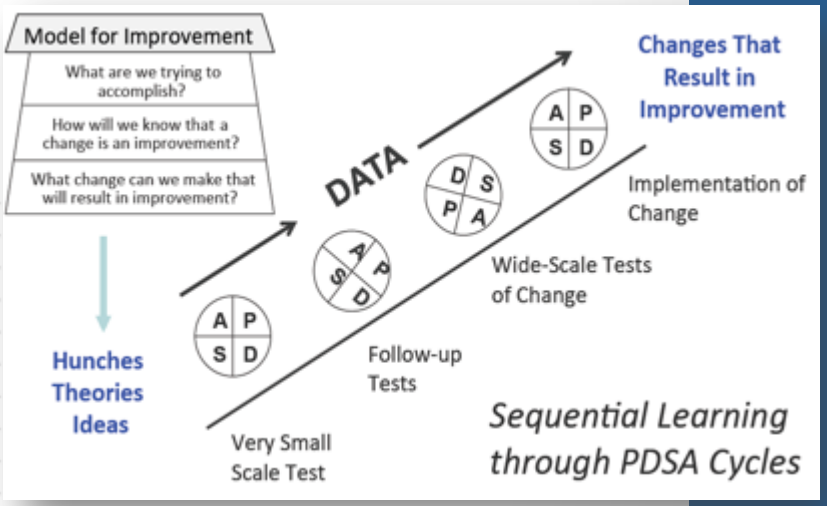
Explain one thing in this unit that you understand better or differently after talking with your partner today.

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

- Patterns in the data
- Hypothesis about a change in the practice process/context
- PDSA(**R**eflect)







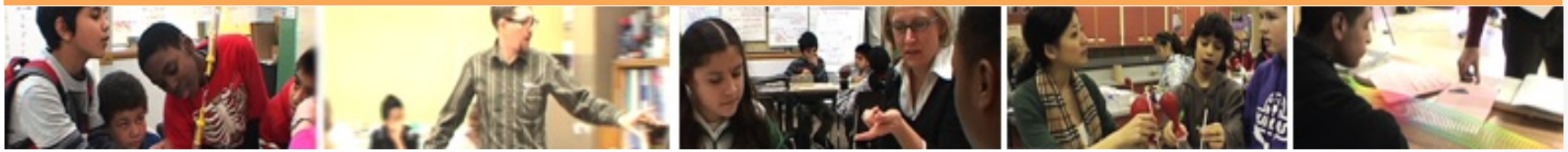
Network Drivers for the practice of structured talk

Network Drivers for Structured Talk

Working on scientific explanations	Creating equitable opportunities to learn
• Press students toward "how" and "why" *Giving students "the what," asking targeted why questions, asking students to use evidence in their models, adding questions and tasks that prompt how/why level writing…* • Engage students in connecting ideas *Providing them with opportunities to juxtapose data/hypotheses/ideas/models, asking them to apply ideas to a new scenario*, using a summary chart to connect activities to the phenomenon…* • Focus students on key science ideas *Clarifying important ideas through targeted just-in-time instruction, using an explanation checklist*…* • Have students track how their thinking has changed over time *Highlighting revised explanations on their models…*	• Ensure students understand the protocol *Sharing directions on how to do structured talk, chunking the protocol so students can get used to each part…* • Provide adequate processing/sharing time *Giving students private think time prior to talking, using a timer to moderate turns…* • Provide access to supportive resources *Reminding students of resources they have available, providing a word bank or sentence stems…* • Create accessible entry points for students *Launching with multiple choice questions*, making students experts on particular parts of the model, pairing students based on comfort…* • Seek out and integrate students' experiences *Asking students to comment on their talk experience (e.g., exit ticket), allowing students to leverage debate-oriented discourse…*
Promoting robust classroom discourse	**Supporting language development**
• Help students think about their engagement in structured talk *Engaging students in self-monitoring or providing explicit feedback, analyzing good videotaped conversations together, explaining why you're using structured talk…* • Create meaningful science contexts for students to work together *Having students work on a joint model, keeping the talk anchored in authentic science, having options for "fast finishers"…* • Plan for sharing out after structured talk *Creating a public record of shared ideas using students' names*, requiring students to write their initial ideas and how their ideas changed in preparation for sharing…* • Scaffold talk norms in the classroom *Modeling the kind of conversation you expect, providing sample questions students could use to press each other for explanation…*	• Identify and plan support for EL students *Differentiating questions for different levels, intentionally pairing students to support language use and development…* • Provide written scaffolds for EL students *Creating sentence frames, providing private write time prior to talking, acknowledging key vocabulary on the board…* • Give EL students extra support before they share with the whole class *Allowing students to confer with partners before sharing, having partners read written comments aloud to practice, pre-selecting students to share and letting them know so they can prepare…* • Encourage multiple language use *Using 1st and 2nd languages with partners*, providing a "gotta have" checklist in Spanish…*

Learnings from ACE
Learnings from Cascade
Learnings from Chinook
Learnings from College Place
Learnings from Evergreen
Learnings from Highline
Learnings from New Start
Learnings from Rainier
Learnings from Renton

Tools for Ambitious Science Teaching



Website: http://ambitiousscienceteaching.org/

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