The power of **MODELING + DISCOURSE**

**IN YOUR SCIENCE CLASSROOM**

Standards, by themselves, have never changed “who gets to participate or how” in our classrooms.

5 principles for expanding participation

1. Create links between science topics and students’ everyday experiences, use their ideas as resources

Who in your classroom participates?

- Can I participate?
- Will I participate?
- Can I see my interests in the science?
- Will people care about my ideas?
Students motivated by events that are important, relevant, connected to events they've experienced or care about, problems that are interesting, realistic

- Sophomore biology: Why did my aunt get breast cancer and will it spread?
- 2nd grade: An apple tree starts to grow on a hillside, where did it come from?
- Kindergarten: How can someone little push someone big off the end of a slide?
- AP Chemistry: Where does the heat go when I pour out my coffee?
- 5th grade: Why are solar eclipses predictable and so rare?
- 8th grade: Why are killer whale populations in Puget Sound declining?

Essential question: How could the re-introduction of a small number of wolves cause dramatic changes in the Yellowstone ecosystem?

What the arc of a unit looks like...

Ecosystems: Yellowstone

- Habitats
- Carrying capacity
- Trophic pyramids: How does energy flow?
- How social behavior helps survival
- Inter-dependence of different species
- Competition for resources
- Changing population data

Discuss with table partners, what do you see in this this final model template? What do you see in the student’s response, beyond “correct or incorrect”??
Why is modeling a valued practice?

- It makes students’ thinking visible to you
- Allows students to show more of what they currently know in variety of ways
- Makes their reasoning available to their peers
- Helps students see that it is valuable to change their thinking in response to new evidence and ideas

Two kinds of explanatory challenges are possible for students:

Students asked to explain AE’s using a “before, during, after” template

Alternatively, students can be asked to explain how two “cases” of an event differ

AP Chemistry thermodynamics: Where does the heat go when I pour out my coffee and why?

Homeostasis is topic: Why did one runner get heat stroke, the other didn’t?

Principle 2 for expanding participation

Make student thinking visible, use multiple modalities

Encourage drawing + talking + gesturing + writing

Posters are not models (i.e. “posterizing”)

If students are reproducing something that could be found in any textbook, then it is not modeling.

If there is nothing genuinely puzzling or students all have the same models, it is not modeling.
Studying the “energy story” behind sound

Inside Ashley’s 6th grade classroom

- Diverse urban K-8 school
- 80% Low income, 47% English Learners
- 20% Homeless

What makes noise vs. music?
Can ultrasound help us see hidden things?
How are auditoriums built to make voices & music clear?

Can technology help us overcome hearing loss?
How does military sonar use affect orcas?
Can a person who is blind echo-locate?

How can “booming” speakers make me shake?
How do neighborhoods cut down on noise pollution?
Your own questions…

Cool stuff

For real? Can people “break glass” with the sound of their voices?
Let’s do some observations...

BEFORE, DURING, AFTER
• Before anything happened, I noticed this...
• While ___ was happening, I noticed this...
• After it happened, I noticed this...

SAW, HEARD, FELT
• I saw something happen...
• I heard this...it sounded like...
• I felt this...

SHAPE, COLOR, SIZE
• Something was this shape, this color, this size, it was in front of, it was behind....

HOW FAST IT HAPPENED
• Something happened slow...
• Something happened fast...

SMALL DETAILS
• I saw a detail, maybe its not important but I want to state it anyway...
• Something seemed missing...

OTHER?
• Your choice!

“Straw inside the glass was freaking out.”

“Flicked the glass, that maybe made a crack...”

“Sound of his voice vibrated the cup and straw.”

Framing: What’s expected of your modeling?

Principle 3 for expanding participation

3 Make explicit 1) the structure of authentic science practices, 2) “hidden rules” about science talk.
Science modeling

1. Listen first, ask question about what students already talking about
2. Use follow-ups, not one question after another
3. Don’t funnel students into using technical language or definition
4. Make eye contact with everyone, get students to comment on peers’ ideas
5. Ask a “leaving question” so they keep talking

Small table visits: Probing for reasoning, prior experiences, language that students feel applies to the phenomenon

• How might the teacher framing be thought of an equity move—increasing participation?
• Are there ideas or puzzlements from Kelanie that could be used as resources for reasoning by her peers?

Modeling to make thinking visible: Is this share-out more than just sharing?
Design safe spaces for talk in small groups and whole class settings.

How can we represent our data in ways that help us make sense of it?

Student created data display

Different kinds of models emphasize different ideas, relationships
Puzzlement about sound moving through box, but not air particles

Day 8

In this video...

• Who has opportunities to talk in this routine?
• What groundwork for talk has likely been laid by the teacher earlier this year? Is there scaffolding or structuring of this conversation that you see evidence for?

Revising models: How has our thinking changed?

- Revise: We think [evidence from activity/reading] supports PART of our model, but we want to change ____ to make it more accurate.
- Add: We think [evidence from summary table] supports PART of our model, but we want to add ____ to make it more accurate.
- Remove or find out more: We think [evidence from activity/reading] contradicts ____ in our model, and we want to remove it or find out more about it.
- Questions: We still have questions about ____

I would change how I show the singer voice vibrating around the room and glass by changing the representations of sound to make it more meaningful, because that just shows music notes that you would see in a music class.
Provide opportunities for students to use new academic language in the context of science conversations (don’t front-load vocabulary).

End of unit: Transferring knowledge to new situation

A final model template

### Day 15

**The question we are answering by drawing this model and writing our explanation:** How did this singer break the glass with his voice?

**Directions:**

1. In the three panels below, draw what is happening that you can and cannot see that is causing the glass to shatter. (Feel free to use color)

2. Use the drawings to help you write an explanation about what is happening at each point in time.

3. For each picture, be sure to include the ideas from the Gotta-Have Checklist:

   - How compression waves move energy
   - How frequency and amplitude play a role in the glass breaking
   - The full story of energy transfers from person to glass
   - How resonance plays a role in the story

4. After completing your model, provide evidence from one class activity that supports one of your claims. Write the evidence on a sticky note and place on the relevant drawing.

**Names: __________________________ Period: ____________

**Gotta-Have Checklist:** in each of the three panels:

- How compression waves move energy
- How frequency and amplitude play a role in the glass breaking
- The full story of energy transfers from person to glass
- How resonance plays a role in the story

**Before**

**After**

**End of unit: Transferring knowledge to new situation**
AP Chem: Where does heat go in my coffee?

How can we stop a hurricane? (6th)

Why can do few wolves change the Yellowstone ecosystem?
Clementina: Using 3 models simultaneously

Coach: Do you think scientists are ever finished with their drawings?

Clementina: No—and they just keep going and keep going

Coach: Why do you think they keep adding stuff?

Clementina: Because they have a lot of ideas so they put it in their papers, and um, if they (teachers) don’t pick you (call on you) then it’s okay because they can do it (kids can show it) in their papers.

Expanding opportunities to be smart

1. Create links between science topic and students’ everyday experiences, use their ideas as resources.
2. Make student thinking visible, use multiple modalities.
3. Make explicit 1) the structure of authentic science practices, 2) “hidden rules” about science talk.
4. Provide opportunities for students to use new academic language in the context of science conversations (don’t front-load vocabulary).
5. Design safe spaces for talk in small groups and whole class settings.

What can we start working on?

What big questions about modeling and sense-making talk do we have?

What non-trivial changes can we experiment with?

How can we use the power of a community of professionals to change our classrooms?

Where do we want to be in our practice, two years from now?