Ambitious teaching = helping all students meet high expectations

Science Methods Fall 2011
“I feel like chemistry is another world. You know what I mean?”

Kim, a junior failing high school chemistry (Costa, 1995)

Recognizing our own and others’ worlds
Producing evidence-based explanations

Three different classrooms, all studying the same science ideas

<table>
<thead>
<tr>
<th>“Anything goes” explanations</th>
<th>Producing legitimate explanations</th>
<th>Reproducing what’s in textbooks</th>
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<tbody>
<tr>
<td>• What does it sound like?</td>
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<td>• What does the process look like?</td>
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<td>• What’s the end product?</td>
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How can I organize my thinking about equitable practices?

- 4 overall avenues
  - Bridge science content with students’ ways of knowing, talking, being
  - Create and preserve safe, inclusive classroom environments
  - Make visible for students 1) the structure of authentic science practices, and 2) “hidden rules” about science talk
  - Use assessment to support rather than narrow learning
Avenue 1 is about *preventing the disconnects* students feel.

**Avenue 1: Bridge science content with students’ ways of knowing, talking, being**

- Ground curriculum content in phenomena that are relatable to student experiences, lives, cultures.
- Plan for building some instruction on students’ own experiences and language.
- Begin instruction by eliciting students’ ideas.
- Incorporate meaning-making time in your lessons—don’t over-emphasize rote memorization, drill, or procedures.
Avenue 2 is about opening up ways for more students to participate in more ways your classroom.

Avenue 2: Create and preserve safe, inclusive environments

- Use group work strategies to accord status to students and to allow them to participate in the intellectual work of science
- Honor alternative ways of communicating—let students talk about ideas in story form, in drawings, using everyday language at first, their analogies, etc.
- Establish and rehearse clear norms for listening and responding to one another’s ideas
- Use students’ questions as a source of learning activity and engagement
- Work daily on relationships with individual students (not just the class as a whole) in which they see you as a person, and you recognize them as human beings with important lives and ideas
- Provide a classroom environment that is open for discourse and intellectual risk-taking. Do people feel free to hypothesize? Disagree?
- Honor alternative ways of communicating—let students talk about ideas in story form, in drawings, using everyday language at first, their analogies, etc.
Avenue 3 is about making visible the practices of science

**Avenue 3: Make visible for students**
1) the structure of authentic science practices, and 2) “hidden rules” about science talk

- Provide a clear view of expert practice for all complex performances you want students to engage in—what does it look like? Sound like?

- Provide prompts for listening and responding—e.g. show how to disagree with ideas, talk about evidence, add on to one another’s’ ideas

- Link students’ everyday language with academic language—let students make sense of phenomena in their own words, but do eventually introduce the vocabulary terms that can act as tools for further reasoning

- Have periodic times for talking about talk itself—what do we mean by “explain” or “predict”?

- Establish, model and reinforce socio-scientific norms—e.g. say “what counts” as an explanation, model it, respond when students attempt it

Attending to Equity & Intellectual Engagement 1/24/2014
What are the key scientific practices?

- Developing and using models
- Asking questions
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics, information, technologies
- Constructing explanations
- Engaging in arguments from evidence
Avenue 4 is about *fair forms* of assessment

**Avenue 4: Use assessment to support rather than narrow learning**

- Provide timely, targeted and individual feedback
- Ask students periodically what they think they need to know, what questions they have, what puzzles them
- Allow multiple forms of assessment, let students show what they know in written form, drawings, spoken word, physical models, etc.
- Plan to differentiate instruction (and assessment) while keeping high expectations for everyone—many students just need more time, a different set of directions, scaffolds for writing, scaffolds for explaining things or representing ideas on paper

**Attending to Equity & Intellectual Engagement**

1/24/2014
Let’s agree to work together

1. Resolve that we won’t figure this all out today or tomorrow, but we’ll take baby steps toward a fuller understanding and towards equitable practices.

2. Let’s be clear about why these moves are hard for us.

3. Let’s then start by thinking about tools, practices we are already familiar with, how they could be used to provide equitable instruction.

4. Share good examples we’ve seen from our own CT’s.

5. Generate our own resources to help us?
High expectations
For further reading:


For further reading:


Border Crossings & Multiple Worlds

Family - Norms - Values - Beliefs - Expectations - Actions

School - Norms - Values - Beliefs - Expectations - Actions

Peer - Norms - Values - Beliefs - Expectations - Actions

Self - Norms - Values - Beliefs - Expectations - Actions

Phelan, Davidson, & Cao (1991)
Which parts do you have questions about?

- Mark, I need clarification on ____________.
- Mark, I am not sure I understand what you mean by ____________.
Why are we answering these questions?

Why?
By prompting yourself to create links between your practice and increased student learning, you can have a better chance to understand why and under what conditions these strategies work. It also helps you avoid “weak” (trivial) applications of this strategy.

Broad avenue of equity consideration: Bridging science content with kids’ ways of knowing, talking, being.

Which teacher strategy am I describing?
Incorporate meaning-making into your lessons—don’t over emphasize memorization, drill or procedures.

Why?
Teachers need images, in concrete terms about what these practices look like and sound like. This specificity helps make our ideas sharable and open for collective refinement by our cohort.

What are the reasons for doing the strategy listed above? Think in terms of a mini-theory that links the strategy with increased opportunities for student learning or participation.

Two full sentences please...
Meaning-making involves reasoning about ideas with others in public discourse; this public discourse is where kids get to hear how other people think and communicate ideas. When kids ways of reasoning and get to “mark” these, then they likely add these ways of communication to their toolbox.

What are two examples of a meaningful “first attempt” we can take as teachers?
Example 1: After 2 or 3 days of activity and reading, where kids have had several chances in small groups to put together pieces of the Big Idea (in the form of an explanation), we can do a round of “kush-ball”. This is where kids stand in a circle and the teacher starts with the ball. He/she begins the round by giving the first sentence of the possible explanation. She/he then asks for a volunteer to take a second sentence or to qualify something the teacher has just said. The teacher scaffolds the participation of others by putting “connecting words or phrases” on the board.

Example 2: I can set aside time at the end of class for student generated questions on a public space about which I still have questions about. I need to find out.

Why?
To help you step outside your world and see the larger context that frames your students experiences in the classroom. It keeps you from becoming overly satisfied with yourself and the status quo. It provides the impetus to change not only classroom routines but entire school structures.

What two critical questions do I have to ask about the intersection of the 3 ways above in order to be effective with this strategy?
You should refer to one of the PowerPoint slides titled: Avenue 1, WorldView Continuum, or Science is cultural.

Question 1: How can I make sure that the meaning the students are making is theirs, rather than regurgitating mine?

Question 2: Kids make meaning when they relate new science ideas other ones they previously understood, but can they also make meaning when they relate new science ideas to their own lived experiences?
Developing lenses to see what kinds of work needs to be done

- Students’ ways of knowing, talking, being
- Perceived ways of doing, knowing, communicating science
- School structures and classroom routines
Border Crossings: What was your experience in school?

I
Congruent Worlds
Smooth Transitions

II
Different Worlds
Boundary Crossings Managed

III
Different Worlds
Boundary Crossings Hazardous

IV
Borders Impenetrable
Boundary Crossings Insurmountable
Science is often presented as culturally neutral, yet students have different views about what counts as science. They may (or may not) have interest in the science “culture” as portrayed in school.

Typically science in schools is presented as authoritative and exclusive:
- As the practice of individual geniuses, not a collaborative process by “real people”
- As a rational endeavor, no room for creativity
- As accumulating facts rather than testing and revising theories (models)
- As “finished science” rather than “science-in-the-making”
- As a static body of “correct” knowledge rather than a tentative set of evolving ideas supported (not proven) by evidence.

As such, students often view science as something that does not connect to their lives and cannot be done by them.
students’ cultural worldviews are often played out in your classroom

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<tr>
<td>Individual effort</td>
</tr>
<tr>
<td>Competition</td>
</tr>
<tr>
<td>Personal achievement</td>
</tr>
<tr>
<td>Success measured in material terms</td>
</tr>
<tr>
<td>Independence</td>
</tr>
<tr>
<td>People control nature</td>
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adapted from Spindler & Spindler & Au (2007)
Avenue 1: Bridge science content with students’ ways of knowing, talking, being

- Building bridges between multiple worlds, ask yourself
  - What assumptions am I making about “what counts” as school science? (use worldviews chart or “Science is cultural” slide)
  - What kinds of experiences have my students had in their worlds outside of the science classroom?
  - What ideas are already part of students’ funds of knowledge?
  - How can I create shared experiences for my students to build bridges between worlds?
An example of bridging science content with students’ ways of knowing, talking, being

- Jessica’s *Lunch Time Science* study – girls’ boundary crossings
  - Helped girls cross borders by bridging their world with world of science.
  - Unit on body systems taught in terms of their health.
    - How do nutrients, drugs (caffeine, alcohol) in body of mother influence development of unborn baby?
    - Unit on respiratory system taught in terms of “Why are rates of asthma higher in the Central District than anywhere else in Seattle?”
Seeing science from another’s perspective

- Example from Jessica’s *Lunch Time Science* study – girls’ border crossings
  - After two months of observation, many girls had not spoken once in their science class. Science to them was for other kinds of folk, and in classroom it was about “vocabulary”
  - Border crossings very difficult: relationship with peers & family was sometimes inconsistent with culture of classroom. And--weak relationship with teacher
  - These girls were failing in school, but invested in things like book clubs, dance, community activity, often showing leadership in these
### Pressing for explanation

<table>
<thead>
<tr>
<th>Depth of Explanation</th>
<th>“What happened” explanation</th>
<th>How/ partial why something happened explanation</th>
<th>Causal explanation</th>
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|                       | ○ Student describes what happened.  
○ Student describes, summarizes, or restates a pattern or trend in data without making a connection to any unobservable/ theoretical components. | ○ Student describes how or partial why something happened.  
○ Student addresses unobservable/ theoretical components tangentially. | ○ Student explains why something happened.  
○ Student can trace a full causal story for why a phenomenon occurred.  
○ Student uses powerful science ideas that have unobservable/theoretical components (like kinetic molecular theory) to explain observable events. |
| EXAMPLE explanation for cellular respiration investigation | The Bromothymol Blue changed color after exercise because the body exhaled more carbon dioxide as compared to when the body is stationary. | When exercising the body requires more oxygen. As oxygen intake increases so does the carbon dioxide output. | When exercising the body requires more oxygen which is taken from the lungs to muscle cells (via the circulatory system and diffusion). The cells use the oxygen to breakdown glucose into energy and carbon dioxide. Muscles use the energy to do work and the carbon dioxide diffuses into the blood and then the lungs and is exhaled. Cellular respiration happens at a faster rate when a person is exercising. |
None of us teach in a vacuum

- National poverty rate for Blacks, Hispanics, and American Indians is triple that of Whites.
- Achievement Gap between low income students of color & their more affluent White peers has existed for years.
- Most teachers and school administrators are Anglo.
- High achieving African American girls are often labeled by their peers as “acting White.”
- Most students and many adults still envision science as a topic for (White, male, genius) scientists.
- Status differences in the classroom can lead students to shut each other down.
Reaching the other 80% of your students
What are the key scientific practices?

- Asking questions
- Planning and carrying out investigations
- Developing and using models
- Analyzing and interpreting data
- Using mathematics, information, computer technologies
- Constructing explanations
- Engaging in arguments from evidence