

College and Career Readiness

Protocol #2 for Secondary Mathematics Teachers: *The Standards for Mathematical Practice*

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Desired Outcomes

A common understanding of

- the processes, proficiencies and habits of mind that are emphasized in the Standards for Mathematical Practice.
- the types of learning opportunities that we are compelled to provide for our students in light of the 8 mathematical practices.

It's not just a new list of stuff to cover

These Standards are not intended to be new names for old ways of doing business. They are a call to take the next step. It is time for states to work together to build on lessons learned from two decades of standards based reforms. It is time to recognize that standards are not just promises to our children, but promises we intend to keep.

— CCSSM (2010, p.5)

All Means All

- The CCSS articulate rigorous expectations to prepare all students to be college and career ready, including English language learners and Special Education students.
- Classroom culture, relationships, learning activities, along with our instructional and assessment practices must reflect a commitment to these expectations for all, while recognizing that some students will require additional instructional support.

A shift in perspective

The CCSS for Mathematics compel a change in the culture of the traditional mathematics classroom.

In the typical mathematics classroom students are "too busy covering content" to be engaged with mathematics.

A shift in perspective

"Math Class Needs a Makeover"

<http://tinyurl.com/danmeyerTEDtalk>

Provoking Students' Thinking

In the video, Dan Meyer recommends that teachers should add the following tool to their repertoire of instructional strategies:

“ask the shortest question you possibly can, and let the more specific questions come out in the conversation.”

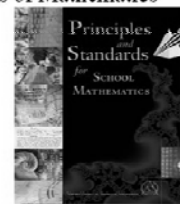
The Standards for Mathematical Practice

Underlying Frameworks

National Council of Teachers of Mathematics

5 Process Standards

- Problem Solving
- Reasoning and Proof
- Communication
- Connections
- Representations

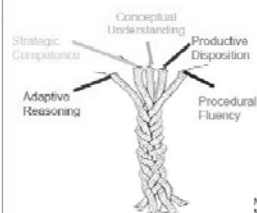


NCTM (2000). Principles and Standards for School Mathematics. Reston, VA: Author.

The Standards for Mathematical Practice

Underlying Frameworks

Strands of Mathematical Proficiency



NRC (2001). Adding It Up. Washington, D.C.: National Academies Press.

The Standards for Mathematical Practice

“Encouraging these practices in students of all ages should be as much a goal of the mathematics curriculum as the learning of specific content” (CCSS, 2010).

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The Standards for Mathematical Practice

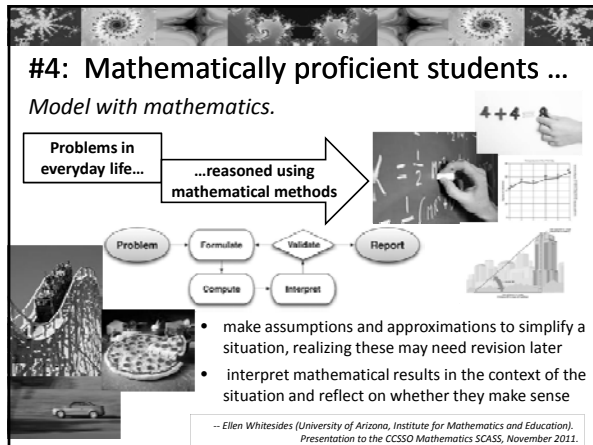
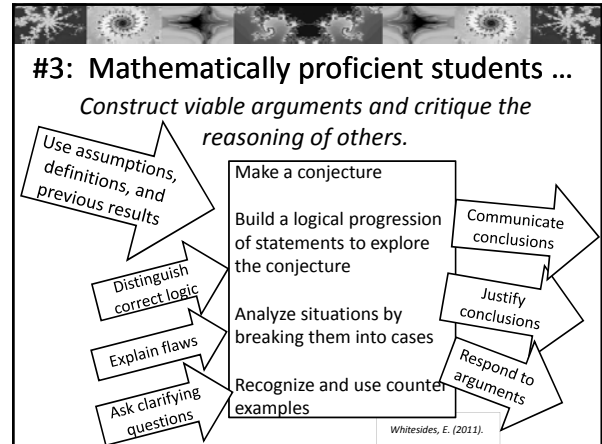
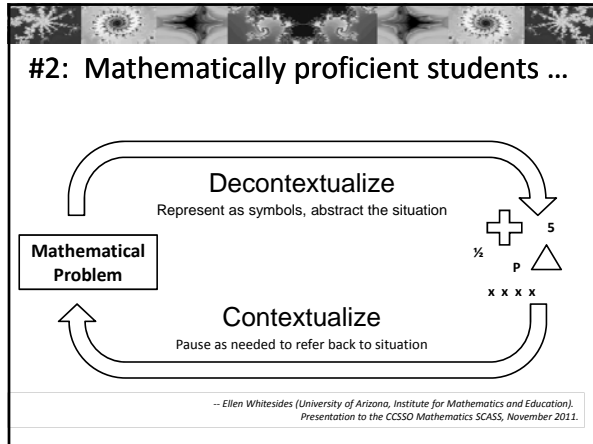
The description of each Mathematical Practice begins with the same first three words:

Mathematically proficient students ...

#1: Mathematically proficient students ...

Make sense of problems and persevere in solving them.

- Explain the meaning of the problem to themselves
- Look for entry points
- Analyze givens, constraints, relationships, goals
- Make conjectures about the solution
- Plan a solution pathway
- Monitor and evaluate progress, and change course if necessary
- Continually ask themselves “Does this make sense?”



#5: Mathematically proficient students ...

Use appropriate tools strategically.

Proficient students

- > are sufficiently familiar with appropriate tools to decide when each tool is helpful, knowing both the benefit and limitations
- > detect possible errors
- > identify relevant external mathematical resources, and use them to pose or solve problems

-- Ellen Whitesides (University of Arizona, Institute for Mathematics and Education).
Presentation to the CCSO Mathematics SCASS, November 2011.

- ### #6: Mathematically proficient students ...
- Attend to precision.*
- > communicate precisely to others; use clear definitions
 - > state the meaning of the symbols they use
 - > specify units of measurement
 - > label the axes to clarify correspondence with problem
 - > calculate accurately and efficiently
 - > express answers with an appropriate degree of precision

#7: Mathematically proficient students ...

Look for and make use of structure.

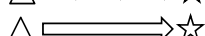
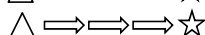
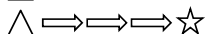
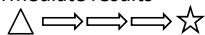
- look closely to discern a pattern or structure
- step back for an overview and shift perspective
- see complicated things as single objects, or as composed of several objects

$$\frac{y_1 - y_2}{(x_1 - x_2)} = \frac{m(x_1 - x_2)}{(x_1 - x_2)} \quad \frac{y_1 - y_2}{x_1 - x_2} = m$$

#8: Mathematically proficient students ...

Look for and express regularity in repeated reasoning.

- notice if calculations are repeated and look both for general methods and for shortcuts
- maintain oversight of the process while attending to the details, as they work to solve a problem
- continually evaluate the reasonableness of their intermediate results



— Ellen Whitesides (University of Arizona,
Institute for Mathematics and Education),
Presentation to the CCSO Mathematics SCASS,
November 2011.

The Standards for Mathematical Practice**Let's hear from the writers of the
Common Core State Standards for
Mathematics**

<http://tinyurl.com/zimbamccallumPRACTICES>

Let's talk: Implications for Instruction**Cause-Effect Template for Mathematical Practice #3**

- Form small groups (4-6 members)
- Read the indicators for MP #3 that are listed in the "effect" column.
- As a group, brainstorm what must I plan in my teaching and learning activities so that I will be able to see evidence of students "constructing viable arguments and critiquing the reasoning of others?"

Keep the momentum going**Cause-Effect Template for Mathematical Practice #3**

- Then, identify a topic or lesson you will be teaching in the next couple of weeks that would be a good opportunity to incorporate some of the items from the list your group just created.
 - Commit to finding or developing an activity addressing MP #3 that you will agree to implement.
 - During a department meeting in the next few months, plan a time on the agenda to share successes and challenges regarding your efforts to incorporate learning activities that engage students with MP #3.