

## Teacher Quality Standard I

**Teachers demonstrate mastery of and pedagogical expertise in the content they teach. The elementary teacher is an expert in literacy and mathematics and is knowledgeable in all other content that he or she teaches (e.g., science, social studies, arts, physical education, or world languages). The secondary teacher has knowledge of literacy and mathematics and is an expert in his or her content endorsement area(s).**

*The key to distinguishing the knowledge base of teaching rests at the intersection of content and pedagogy.*

—L. S. Shulman

To teach all students according to today's standards, teachers need to understand subject matter deeply and flexibly so they can help students create useful cognitive maps, relate one idea to another, and address misconceptions. Teachers need to see how ideas connect across fields and to everyday life. This kind of understanding provides a foundation for pedagogical content knowledge that enables teachers to make ideas accessible to others. (Shulman, 1987)

Although Shulman's work dates back to the late 1980s, the importance of teacher content knowledge and pedagogical expertise has never been more important than it is now as teachers ensure students are college and career ready for the demands of the 21<sup>st</sup> century.

### Element C: Math Teachers

**Teachers demonstrate knowledge of mathematics and understand how to promote student development in numbers and operations, algebra, geometry and measurement, and data analysis and probability.**

This section describes professional practices that should be demonstrated by Teachers responsible for teaching math.

*The great book of nature can be read only by those who know the language in which it was written. . . and that language is mathematics.*

—Galileo

Professional practices appearing under each element of the Rubric for Evaluating Colorado Teachers are cumulative. Therefore, for teachers of math to be proficient in demonstrating knowledge of mathematics and how to promote student development of mathematical concepts and skills, they must provide instruction that is a balance of conceptual understanding and procedural skills and is sequenced and appropriate for the age and grade of their students. Teachers also establish an environment where



[Click here to go back to the table of contents and view the resource guide in its entirety.](#)

students are actively engaged in doing math that challenges their thinking, stimulates their curiosity, and encourages them to investigate further.

## **PROFICIENT RATING LEVEL**

### **PROFESSIONAL PRACTICES: THE TEACHER:**

#### **Establishes an effective mathematics environment by:**

- ***Challenging students to think deeply about the problems.***

Challenging students to think deeply about problems means that the teacher must engage students in problems that are worth thinking about. It is no longer enough to focus on simple problems that suggest a simple solution. Instead students should build on skills and knowledge to dig into real world problems for which a solution might have to be weighed against another possible solution, such as the real costs over time of a new car versus a used car. Inevitably more complex problems will require students to struggle. The effective teacher provides the support for students to engage in productive struggle that “facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.” (Principals In Action, 2014, p. 10)

The Standards for Mathematical Practice are standards for students about the ways to act, think and work like a mathematician.

#### ***Refer to these external resources for additional information:***

- Article: “Launching Complex Tasks” by Kara Jackson  
[http://standardstoolkit.dpsk12.org/files/Article\\_Launching\\_ComplexTasks.pdf](http://standardstoolkit.dpsk12.org/files/Article_Launching_ComplexTasks.pdf)  
Article describes four elements of challenging mathematical problems that support the learning of all students.
- Website: Problem Solving maintained by Principles and Standard for School Mathematics  
<http://www.fayar.net/east/teacher.web/math/Standards/document/chapter3/prob.htm>  
Website explains the importance of having students engage in problem solving activities and describes strategies for doing this in the classroom.

- ***Requiring students to explain their solutions.***

When students are challenged to think and reason about mathematics and to communicate the results of their thinking to others orally or in writing, they learn to be clear and convincing. Listening to others' explanations gives students opportunities to develop their own understandings. Conversations in which mathematical ideas are explored from multiple perspectives help the participants sharpen their thinking and make connections. Students who are involved in discussions in which they justify solutions—especially in the face of disagreement—will gain better mathematical understanding as they work to convince their peers about differing points of view (Hatano and Inagaki 1991). Such activity also helps students develop a language for expressing mathematical ideas and an appreciation of the need for precision in that language. Students who have opportunities, encouragement, and support for speaking, writing, reading, and listening in mathematics classes reap dual benefits: they communicate to learn



[Click here to go back to the table of contents and view the resource guide in its entirety.](#)

mathematics, and they learn to communicate mathematically. (Principles and Standards for School Mathematics, 2000)

Standard 3 for Mathematical Practice is to construct viable arguments and critique the reasoning of others. For students to master this practice, they must have opportunities to justify and explain, with accurate mathematical vocabulary, how they arrived at their solution and develop the skill of critiquing others' reasoning.

*Refer to this external resource for additional information:*

- Website: Reasoning and Proof maintained by Principles and Standard for School Mathematics  
<http://www.fayar.net/east/teacher.web/math/Standards/document/chapter3/reas.htm>  
Website explains the importance of having students explain their solutions by providing reasons and proof.
- ***Posing questions that stimulate students' curiosity and encourage them to investigate further.***

Our minds (teachers) must stimulate theirs (students) with questions and yet further question; questions that probe information and experience; questions that call for reasons and evidence; questions that lead students to examine interpretations and conclusions, pursuing their basis in fact and experience; questions that help students to discover their assumptions, questions that stimulate students to follow out the implications of their thought, to test their ideas, to take their ideas apart, to challenge their ideas, to take their ideas seriously. It is in the totality of this intellectually rigorous atmosphere that natural curiosity thrives. (Paul, Willson, & Binker, 1995)

Strategies for improving classroom discourse:

- *Create a classroom culture open to dialogue:* Students feel free to respond to the teacher's questions, challenge peers' responses, and ask their own questions.
- *Use both preplanned and emerging questions:* The teacher preplans questions that will be asked based on the learning objective and students. However, questions are also asked that result from students' response and questions.
- *Address questions to the group or to individuals randomly:* A variety of response methods is utilized to engage all students in responding to questions and to hold students accountable for formulating responses and developing their own questions.
- *Use sufficient wait time:* Provide students sufficient time to formulate responses. Communicate the expectation that everyone needs a few seconds of "think time" to process the question and their response.

*Refer to these external resources for additional information:*

- Article: "Four Strategies to Spark Curiosity via Student Questioning" by Kevin D. Washburn  
<http://www.edutopia.org/blog/build-curiosity-questioning-strategies-kevin-washburn>  
Article describes strategies for stimulating student curiosity through questioning.
- Article: "How to Get Students Talking! Generating Math Talk that Supports Math Learning" by Lisa Ann de Garcia  
<http://www.mathsolutions.com/documents/How to Get Students Talking.pdf>  
Article defines discourse in the mathematics classroom and describes practices for high-quality discourse.



[Click here to go back to the table of contents and view the resource guide in its entirety.](#)

- Article: “Never Say Anything a Kid Can Say” by Steven Reinhart  
<https://www.georgiastandards.org/resources/Online%20High%20School%20Math%20Training%20Materials/Math-I-Session-5-Never-Say-Anything-a-Kid-Can-Say-Article.pdf>  
 Article describes questioning process used by a teacher and includes several strategies he has had success with in his classroom.

*See also Standard II, Element C and Standard III, Element E.*

- **Actively engaging students in doing math.**

When the teacher is proficient in implementing the professional practices listed under the Proficient level, students will be actively engaged in doing math. By challenging students to think deeply about problems, requiring them to explain their solutions, and posing questions that stimulate curiosity and investigation, the teacher establishes an engaging environment for students to do math.

- **Using real-world examples for problems whenever possible.**

When students have opportunities to engage in real-world problems, their motivation increases because learning becomes more meaningful. Alberti (2013) notes “Application can be motivational and interesting, and students at all levels need to connect the mathematics they are learning to the world around them” (para. 29). The need to learn math content and skills becomes purposeful as they are able to relate mathematical thinking to their interests and life experiences.

*Refer to these external resources for additional information:*

- Article: “Bringing Mathematics to Life” by Scott Willis and Kathy Checkley  
<http://www.ascd.org/publications/curriculum-update/summer1996/Bringing-Mathematics-to-Life.aspx>  
 Article explains the importance of real-world applications and includes ideas for classroom instruction.
- Article: “Making Math Relevant” by Susan Kelly-Bryan  
<http://teachers.greenville.k12.sc.us/sites/kstables/Shared%20Documents/AL0406MakingMathRelevant%5B1%5D.pdf>  
 Article describes strategies for making math relevant to students’ lives.



[Click here to go back to the table of contents and view the resource guide in its entirety.](#)