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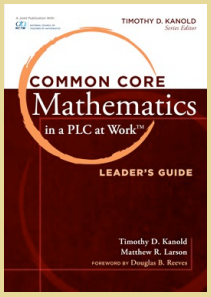

File: Mathematics and the Common Core

Common Core Mathematics in a PLC at Work™, Leader's Guide

By Timothy D. Kanold and Matthew R. Larson (Solution Tree Press, 2012)

S.O.S. (A Summary of the Summary)

The main ideas of the book are:

~ To help mathematics leaders focus their time and effort on those high-impact actions that will translate into improved student learning.
~ To outline the five priority areas leaders must focus on to ensure students meet the Common Core State Standards in mathematics.

Why I chose this book:
Many of you emailed to ask for a book about math and the Common Core, but it took a while to find the right one.

I particularly like that this book is aimed at leaders and the role they can (and should!) play in facilitating the implementation of the new math CCSS. This book contains some excellent questions and tools you can use to help your math teachers discuss math instruction *and* that you can use to *monitor* the effectiveness of their implementation.

Depending on your background and comfort level you can take these suggestions yourself or pass them along to a math department chair, team leader, or instructional leader.

The Scoop (In this summary you will learn…)

✓ *The five important shifts your math teachers need to make in order to meet the CCSS:*
1) Collaboration, 2) Instruction, 3) Content, 4) Assessment, and 5) Intervention

✓ *The concrete tools, questions, and structures to put in place be an effective leader of math instruction*

✓ *Why you need your math teachers to work collaboratively in teams to best address the CCSS*

✓ *The two important questions all math teachers must address to master the Standards for Mathematical Practice*

✓ *The changes math teachers must make to best implement the Common Core mathematics content standards*

✓ *How to help your math teachers place assessment at the heart of the teaching-assessing-learning cycle*

✓ *How to help your teachers understand the importance of intervention and equity in math*

✓ *PD suggestions to help you improve your own leadership skills in math as well as your math teachers' skills*

Introduction

Although the majority of states have now adopted the Common Core State Standards (CCSS), those standards themselves will not improve student achievement. The standards require the support of leaders in order to effect real change. The authors have written this book to provide guidance for *leaders* in the implementation of the Common Core math standards. The standards serve as a catalyst for real change, and this book will help leaders outline and communicate the shifts in *beliefs* as well as *actions* that are required to raise mathematics achievement to the rigorous levels required in the standards. The book helps leaders understand where to focus their time and energy. The five priorities that all math leaders should focus on are listed below. Each topic is described in more detail in an upcoming chapter. If we hope to see real change and improvement in our students, our staff must make the following five shifts:

1. Collaboration: The CCSS demand a shift in the "grain size of change" from the *individual* to the *collaborative team.* As the leader, it is your job to provide the structures, conditions, and culture necessary for a school to make this shift. (Chapter 1)
2. Instruction: The CCSS in mathematics require that teachers engage students in deep and rigorous understanding as well as mastering procedural fluency. It is vital that leaders communicate this vision of mathematics instruction. (Chapter 2)
3. Content: The shift in the mathematics CCSS requires that teachers learn to teach *fewer* standards with *more depth*. As the leader, you will need to ensure that collaborative team-planned units are aligned to the rigor of the CCSS. (Chapter 3)
4. Assessment: The CCSS call for changes in the way we use assessment. Rather than solely as an *ends* to report what students know, assessment must now be used more *formatively* to help teachers address gaps in student mastery of the CCSS. Your role as leader is to provide a vision for use of *ongoing* mathematics assessments to improve teaching and learning. (Chapter 4)
5. Intervention: The CCSS require that we respond to struggling students differently. Intervention can no longer be invitational – it must now be required. You need to clarify how staff should respond when students struggle to meet the new standards. (Chapter 5)

Chapter 1 – Leading High-Performing Collaborative Teams for Mathematics

Although the K-12 CCSS for mathematics are ambitious, these standards *are* attainable with strong leadership that provides teachers with the *right kind* of professional development. Teachers need professional development that is *ongoing* and *embedded* in their work, not a single out-of-school workshop. The way to provide this is through the creation of high-performing, collaborative teacher teams. One of the key components of schools that are successful in closing the mathematics achievement gap is their strong use of collaborative teams to improve instruction. The collaborative team helps to remove barriers to meeting the mathematics CCSS. By meeting as a team, teachers can eliminate the weeks of reteaching at the beginning of each year as well as build their capacity to understand the standards and implement best practices. Furthermore, when working as a team, the focus becomes *our* students rather than *my* students as teachers work together to ensure that all succeed. As the leader, it is your job to ensure that teams have enough resources and support to focus on the following key questions:

1. What and how should students learn to meet the CCSS for mathematics?
2. What common and coherent assessments should be used to determine what students have learned?
3. How do we respond collectively when students don't meet the CCSS for mathematics?
4. How do we response collectively when students *do* meet the CCSS for mathematics?

<u>Ensure that your teams are truly collaborative</u>
Many schools employ teacher teams or even call themselves a PLC, but as the leader it is important to examine whether your teams are truly engaging in the type of *collaborative* work that makes teams effective. For example, many teams merely *cooperate* – they share information with no concrete goal in mind. For example, one teacher might share how she teaches a learning target about triangles, but the other teachers still have the authority to teach and assess this learning target any way they see fit. Or, teachers may *coordinate* which involves a bit more planning, however it does not lead to high-leverage work. *Collaboration*, on the other hand, requires interdependence that leads to success for *all* students, not just those in one teacher's class. Take a look at the table below to determine how collaborative your teams truly are:

Level of Team Work	Stage	Questions That Define This Stage
COOPERATION	**Stage one**: Filling the time	What exactly are we supposed to do as a team?
	Stage two: Sharing personal practice	What is everyone doing in his or her classroom for instruction, lesson planning, and assessment?
	Stage three: Planning, planning, planning	What should we be teaching during this unit, and how do we lighten the load for each other?
COORDINATION	**Stage four**: Developing common assessments	How will we know if students learned the standards? What does mastery look like for the standards in this unit?
	Stage five: Analyzing student learning	Are students learning what they are supposed to learning? Do we agree on student evidence of learning?
COLLABORATION	**Stage six**: Adapting instruction to student needs	How can we adjust instruction to help those students struggling and those exceeding expectations?
	Stage seven: Reflecting on instruction	Which lesson-design practices are most effective with our students?

Five Ways Leaders Can Support Teams to Get to the "Collaboration" Level

Leaders can provide guidance in the following five areas to help their teams move toward the "collaboration" level.

1. Participation – Leaders must ensure that all teachers participate in appropriate collaborative teams. In larger schools these teams might include all teachers of a particular course, content level, or grade level. In smaller schools in order to make sure teams are not too small, leaders may group all teachers of a grade band – such as 3-5 – together, or may expand groups to include colleagues at other schools with whom they can communicate online.

2. Commitments – Leaders must clearly communicate what they expect collaborative work will look and sound like. They should ensure that teams develop the norms, or collective commitments, by which they will operate. So this doesn't become overwhelming, it is helpful to stick to three or four collective commitments, such as the following: "(1) listen to understand others, (2) challenge ideas respectfully, and (3) keep the agenda focused on teaching and learning" (page 16). As the leader you can help team members hold each other accountable by helping teams outline a process for what to do when norms are not honored. This may take the form of a conflict-resolution plan.

3. Leaders – Collaborative teams need intentional and thoughtful leadership. Whether there is one team leader or the role rotates, the role of the leader is to ensure that there is training and support for team leaders.

4. Agendas and Meeting Minutes – There are tools teams use to make the most of their time such as agendas and minutes. Agendas should be planned in advance so teachers can come to meetings with ideas, and as the leader you can monitor meetings by giving feedback on these agendas. Minutes not only capture the content of the meetings, but they also serve as a tool to communicate beyond the team. These should be kept short so they don't become a burden and can be posted on a wiki, blog, or website.

5. Team Time – The countries with students who perform the highest in math provide significant time for mathematics teachers to collaborate and learn from one another. As the leader you need to find time during the day for teams to meet. In addition to regularly scheduled meetings, you can have an early-release day, use substitute teachers, or compensate teachers for weekend or summer work.

Actions of High-Performing Teams

Another key role for the leader is to make sure that mathematics collaborative teams are focusing their time on the *right actions*. Below are high-leverage actions teams should be focusing on (all center around teaching, learning, and assessment):

- The team agrees on prior knowledge to be assessed and the learning to be taught in the unit.
- The team agrees on lesson-design elements and ensures that CCSS Mathematical Practices are included in each unit.
- The team designs ways for students to demonstrate their learning in each lesson.
- The team designs agreed-on common assessments and implements common scoring and feedback.
- The team designs agreed-on adjustments to teaching and student support based on formative assessments.
- The team agrees on levels of rigor for classroom and homework tasks.
- The team designs agreed-on methods to teach students to self-assess and set goals.

Chapter 2 – Leading the Implementation of the Common Core Standards for Mathematical Practice

The US has a long history of hoping that new standards or a new curriculum would improve student learning in mathematics. However, neither change has led to a significant improvement in student achievement. Instead, to truly improve student learning in math we need to look at *how* mathematics is taught. The Common Core State Standards for Mathematical Practice address the issue of how mathematics should be taught. They describe what students should be *doing* as they learn the mathematics content standards. In fact, college professors rate the Mathematics Practices as *more important* than the content standards in helping students achieve in college.

It is your job as the leader to make it clear that in order to fully adopt the CCSS for Mathematical Practice, there must be a major paradigm shift at the school. It is no longer sufficient to teach students mathematical procedures and algorithms. Now students must engage in deeper understanding, reasoning, and problem solving. You must know whether *procedural fluency* is currently the focus of math classes at your school. If so, outline a vision for mathematics instruction that clarifies what the practices, tasks, and questions *should* look like in math class.

The Standards for Mathematical Practice are *not* a checklist, but rather a set of *processes* and *proficiencies* students must engage in and master. This chapter takes a look at the eight Standards for Mathematical Practice and provides suggestions for ways teams can discuss and more deeply delve into these standards.

The eight Mathematical Practices can be divided into four categories: (1) Overarching habits of mind, (2) Reasoning and explaining, (3) Modeling and using tools, and (4) Seeing structure and generalizing.

Framework for Organizing the Eight Mathematical Practices	
Overarching Habits of Mind Mathematical Practice 1: Make sense of problems and persevere in solving them. Mathematical Practice 6: Attend to precision.	**Reasoning and Explaining** Mathematical Practice 2: Reason abstractly and quantitatively. Mathematical Practice 3: Construct viable arguments and critique the reasoning of others.
	Modeling and Using Tools Mathematical Practice 4: Model with mathematics. Mathematical Practice 5: Use appropriate tools strategically.
	Seeing Structure and Generalizing Mathematical Practice 7: Look for and make use of structures. Mathematical Practice 8: Look for and express regularity in repeated reasoning.

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Collaborative teams can discuss the following two questions for *each* of these Mathematical Practices (page 30):

1. What is the intent of this CCSS Mathematical Practice?
2. How can the collaborative team address this CCSS Mathematical Practice?

Below are some more suggestions for organizing these discussions.

A. Organizing Habits of Mind: Mathematical Practices 1 and 6 (MP1 and MP6)

Question 1: What is the INTENT of Mathematical Practices 1 and 6?
Unfortunately, research shows that rather than challenging students and allowing them to persevere when solving problems, math teachers jump in to remove barriers and minimize confusion leaving students to simply follow a set of procedures. Instead, we need to ensure that math teachers provide opportunities for students to "Make sense of problems and persevere in solving them"(Mathematical Practice 1) as well as "Attend to precision" (Mathematical Practice 6). Clearly, solving problems lies at the heart of mathematics and students need to communicate their learning precisely and correctly.

As the leader, it is your job to ensure that teachers understand what it means for students to be proficient in these two Practices. Student proficiency in these areas would mean students demonstrate the following (and you can observe for these in classrooms):

Mathematical Practice 1: Make sense of problems and persevere in solving them *AND* Mathematical Practice 6: Attend to precision
Subskills: • Students make conjectures about the meaning of a solution and plan an approach to the solution. (MP1) • Students try special or simpler cases to gain insight. (They hypothesize and test conjectures.) (MP1) • Students monitor and evaluate their progress and discuss this with peers. (MP1) • Students understand multiple approaches and ask the question, "Does this solution make sense?" (MP1) • Students communicate precisely using clear definitions when discussing their reasoning. (MP6) • Students calculate accurately and efficiently using the appropriate units of measure. (MP6)

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Question 2: How can collaborative teams address Mathematical Practices 1 and 6?
To adequately engage students in persevering in problem solving, teachers need to find the *right tasks*. Below are some criteria teachers can use in choosing the best problems. Furthermore, leaders can examine classroom tasks and look for these as well:

- Is the problem *interesting* and *challenging* to students?
- Does the problem involve *meaningful* mathematics?
- Does the problem provide an opportunity for students to *apply* and *extend* mathematics?
- Does the problem allow for *multiple strategies* or *multiple solutions*?

When teachers collaboratively plan their lessons, they should discuss how they will make sure their students attend to precision. In their planning, they can map out the important vocabulary of the lesson as well as the expectations for student clarity and accuracy. When planning common assessments, the team should also outline how they will *assess* precision, clarity, and accuracy.

B. Reasoning and Explaining: Mathematical Practices 2 and 3 (MP2 and MP3)

Question 1: What is the INTENT of Mathematical Practices 2 and 3?
When students reason they try to make sense of a problem by thinking through ideas, considering examples and alternatives, asking questions, pondering, etc. (MP2: Reason Abstractly and Quantitatively) When they construct and critique arguments they need to judge and justify their own thinking as well as the thinking of others (MP3: Construct Viable Arguments and Critique the Reasoning of Others). Teachers need to structure meaningful class discussions daily so students can practice these skills.

To understand the intent of these practices, teachers should consider the subskills students need in order to demonstrate proficiency:

MP 2: Reason abstractly and quantitatively *AND* MP3: Construct viable arguments and critique the reasoning of others
Subskills: • Students can decontextualize a problem by representing a problem symbolically to solve it. (MP2) • Students can contextualize a problem by attending to the meaning of the quantities involved in the problem. (MP2) • Students make conjectures, explore the truth of those conjectures and justify and communicate their conclusions. (MP3) • Students listen, read, and respond to the arguments of others for sense making and clarity. (MP3)

Question 2: How can the collaborative team address Mathematical Practices 2 and 3?

To implement these practices, collaborative teams must come together to design common, high-cognitive-demand tasks that get students to reason and explain. Furthermore, they should work together to plan class discussions – every day – that get students to make conjectures, back up their conclusions, and respond to the arguments of their peers. Below are some questions teachers can use in their planning and leaders can use when observing for these Mathematical Practices:

- What are the expectations for *reasoning* and *explanation* in this problem or task? (MP2)
- What questions can teachers ask if students get stuck with this problem? What scaffolding is necessary? (MP2)
- How will students provide justifications in the solution or in class discussion? (MP3)
- How will students make sense of the solutions of their peers through asking questions for clarification? (MP3)

C. Modeling and Using Tools: Mathematical Practices 4 and 5 (MP4 and MP5)

Question 1: What is the INTENT of Mathematical Practices 4 and 5?

It is vital that teachers establish relevance and connections to the real world by providing opportunities for students to solve real-world problems that come from everyday life, society, and the workplace (MP4: Model with mathematics). All classrooms should be equipped with the tools for students to do so (MP5: Use appropriate tools strategically). Of course, these Mathematical Practices, like the others, do not exist in isolation. To use tools to solve real-world problems, students will also need to know how to reason, justify their conclusions, and persevere in problem solving. Below are subskills students will need to master these Mathematical Practices:

Mathematical Practice 4: Model with mathematics *AND* Mathematical Practice 5: Use appropriate tools strategically
Subskills: • Students represent mathematical concepts by using tools such as diagrams, tables, charts, graphs, calculators, and volume models. (MP4) • Students use symbols and tools to represent real-world situations. (MP4) • Students choose the appropriate tool for the task at hand. (MP5) • Students know the limits of the tools they use for providing accurate solutions and can estimate reasonable solutions without the tool. (MP5)

Question 2: How can the collaborative team address Mathematical Practices 4 and 5?

Collaborative teams need to work together to develop a set of appropriate real-world tasks they can present to students. They should begin to keep a list of engaging real-world problems and share and solve these problems with the team. Not only do they need to make the necessary tools available to students to solve these problems, but they must provide the guidance to teach students to select the most appropriate tools. Teachers must consider the accuracy of student solutions when using certain tools and how students are using technology to represent and communicate mathematical concepts.

D. Seeing Structure and Generalizing: Mathematical Practices 7 and 8 (MP7 and MP8)

Question 1: What is the INTENT of Mathematical Practices 7 and 8?

Part of the beauty of math is its underlying structure. For example, see the structure in the following: *Every square is a rhombus* (geometry), and *An even number plus an even number always results in an even number* (basic operations). Teachers need to help students learn to look for the underlying structure when solving problems (MP7: Look for and make use of structure). This is not easy and may require significant professional development. In addition, students must learn to look beyond solving an individual problem to make generalizations for how to solve certain types of problems (MP8: Look for and express regularity in repeated reasoning). Below are some subskills students need in order to master these practices:

Mathematical Practice 7: Look for and make use of structure *AND* Mathematical Practice 8: Look for and express regularity in repeated reasoning
Subskills: • Students consistently search for the structure of mathematics. (MP7) • Students engage in exploring numerical and visual patterns that reveal the structure. (MP7) • Students notice and can articulate patterns that can become generalized properties or formulas. (MP8)

Question 2: How can the collaborative team address Mathematical Practices 7 and 8?

Below are some questions to help teachers address these two practices in planning lessons, tasks, and discussion questions:

- What is the mathematical structure present in this unit? (MP7)
- How can we avoid teaching shortcuts or memorized procedures before students build understanding? (MP8)
- What types of examples and counterexamples can we provide to help students notice if patterns repeat? (MP8)

Lesson-Design Elements and Lesson Design that Support the CCSS Mathematical Practices

Even though teachers are taught about different lesson-design elements in their preservice training, many of them abandon the thorough lesson plan for an abbreviated version. Further, lesson designs often differ from teacher to teacher even in the same mathematics department or grade. Is this true in your school or district? Although there is no one perfect template, one way to ensure that teams consistently emphasize the Mathematical Practices is to have them utilize lesson components that support these practices. Take a look at this excerpted lesson template and see how the Mathematical Practices are woven into it:

Learning target: As a result of today's class, students will be able to_____		
Formative assessment: How will students demonstrate mastery of the learning target using in-class checks for understanding?		
Probing Questions for Differentiation on Mathematical Tasks		
Assessing Questions (Create questions to scaffold for those who get "stuck.")	**Advancing Questions** (Create questions for students ready to advance beyond the learning target.)	
Targeted Standard for Mathematical Practice: Which Mathematical Practice will this lesson highlight?		
Tasks	**What will the teacher be doing?**	**What will the students be doing?**
Beginning Routines: How does the warm-up connect to prior knowledge or HW?		
Task 1: How will the students engage in understanding the learning target?		
Task 2: How will the task develop sense making and reasoning?		
Task 3: How will the task require student conjectures and communication?		
Closure: How will student questions and reflections be solicited? How will understanding of the target be determined?		

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This chapter has a number of useful tools. This final tool below will help leaders by providing look-fors when they observe classes. Below is a list of the type of student behaviors that serve as evidence of the Mathematical Practices.

Mathematical Practice	Look-Fors: Classroom Indicators
MP1: Make sense of problems, and persevere in solving them.	**Students:** Are engaged in problem solving and high-cognitive-demand tasks **Teacher**: Provides enough time and formative feedback for students to discuss problem solutions with peers
MP2: Reason abstractly and quantitatively.	**Students**: Are able to contextualize or decontextualize problems **Teacher**: Provides access to representations (manipulatives, drawings, etc.) of problems and asks questions to elicit reasoning
MP3: Construct viable arguments, and critique the reasoning of others.	**Students**: Use prior learning in constructing arguments **Teacher**: Provides opportunities for students to listen/read/hear the arguments of others and encourages them to question and provide their own arguments
MP4: Model with mathematics.	**Students**: Analyze and model relationships mathematically (eg., an expression or equation) **Teacher**: Provides contexts for students to apply math
MP5: Use appropriate tools strategically.	**Students**: Use instructional tools to deepen understanding (technology, manipulatives) **Teacher**: Provides and demonstrates appropriate tools
MP6: Attend to precision.	**Students**: Recognize need for precision and use appropriate math vocabulary **Teacher**: Emphasizes the importance of precise communication
MP7: Look for and make use of structure.	**Students**: Look for patterns and structure within mathematics **Teacher**: Provides time for students to discuss patterns and structure
MP8: Look for and express regularity in repeated reasoning.	**Students**: Reason about strategies and check for reasonableness of results **Teacher**: Encourages students to look for and discuss regularity in their reasoning

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Chapter 3 – Leading the Implementation of the Common Core Mathematics Content

The Standards for Mathematical Content are a mix of procedures and understanding. This chapter describes your role in facilitating the collaborative teams' implementation of the math CCSS content standards. By this point, it is clear that the important paradigm shift in the math CCSS is *less is more*. There are fewer math standards per year, but students are expected to develop a deeper *understanding* of those standards. There are four critical content issues you must help your grade-level or course-based collaborative teams address: "(1) *Understanding* the domains, content standard clusters, and learning progressions; (2) Seeking *adequate time* to teach the content; (3) Accessing *appropriate technology* and *strategic tools*; and (4) *Implementing* the CCSS content standards" (page 64). Each of these is discussed in a section below.

(1) Understanding the domains, content standard clusters, and learning progressions

As the leader, you must ensure that your teams develop a *shared* understanding of the content they must teach at each grade level. If you haven't already, you can help teams conduct open and thoughtful discussions in order to develop a shared understanding of the content standards. Below is a tool you can provide for teachers to help them analyze the standards. The tool helps teachers discuss what is new about the standards, what is familiar, and which standards need more analysis. This is an example used for high school teachers for geometry but the tool can be used for any grade level mathematics team.

Similarity, Right Triangles, and Trigonometry (G – SRT)			
Content Standard Cluster	*Which Standards in the Cluster are Familiar?*	*What's New or Challenging in These Standards?*	*Which Standards in the Cluster Need Unpacking or Emphasizing?*
Understand similarity in terms of similarity transformations.			
Prove theorems involving similarity.			
Define trigonometric ratios, and solve problems involving right triangles.			
Apply trigonometry to general triangles.			
General Comments:			

In addition to unpacking each standard, it is important that teachers understand that the grouping of standards within a content standard cluster is *intentional*. The relationship between and among standards is important. To develop a complex understanding of the CCSS, teachers need to understand the *learning progressions* and be able to connect the standards across grade levels so they know what comes before and after a learning target.

(2) Seeking *adequate time* to teach the content

Historically, teachers have taught one standard in one day in order to cover all of the necessary standards. This meant teachers doled out small, discrete pieces of unconnected learning each day. Now the CCSS shift means that teachers will teach one standard over the course of several days, or several standards at once, in order to help students understand the big and connected ideas of mathematics. For example, teachers may address just four or five standards (and assess them!) in three weeks. As the leader, you can examine the pacing calendars of collaborative teams to ensure that enough time is allotted for the teaching and assessing of standards.

(3) Accessing *appropriate technology* and *strategic tools*

The standards clearly call for students to learn to use technological tools and models in learning mathematics. The question is no longer whether technology will be integrated into instruction, but rather, *how well*. Technology, tools, and manipulatives should not be included for their own sake, but rather to enhance learning. Collaborative teams need to purposefully plan how they intend to integrate technology (graphing calculators, table applications, web 2.0 tools, interactive games, blogs, etc.) As the leader, in addition to making sure that teams have access to the tools they need, you should also make sure that technology is being used *effectively*. Below are four effective, research-based uses for including technology (from page 73):

- To increase student *interactivity* with content.
- To *differentiate* content.
- To increase student-to-student *collaboration* and *discussion.*
- To collect and organize *feedback* for students and teachers using formative assessment processes.

In addition, teacher teams can use the following questions to help students choose the most appropriate technology tools (from page 74):

1. Does it provide a meaningful model to support the mathematics?
2. Does the tool extend student thinking about a mathematical topic?
3. Is the tool necessary?
4. Is the tool easy to use?
5. Does the tool support students in solving a problem?

(4) *Implementing* the CCSS content standards

A primary role of the leader is to ensure that the CCSS are actually *implemented* in mathematics classrooms as they were intended. To do this, you should look for the following four key elements to effective implementation:

a. Clearly articulated common *learning targets*
b. Common *teaching strategies*
c. Identified common *unit tasks*
d. Common in-class *formative assessments*

To begin, teams must work together to make sure their learning targets meet the high cognitive demand of the mathematics CCSS. To make these accessible to students, teams must then translate them into student-friendly language. Below are two examples of learning targets – one at the high school level (algebra) and one at the second grade level (two-digit subtraction):

CCSS Standard Description	**Student-Friendly Learning Target** (from unpacking the standards)
(HS Algebra) Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	I can estimate to an appropriate level of accuracy.
(2nd Grade Subtraction) Explain why addition and subtraction strategies work, using place value and the properties of operations.	I can explain my thinking when I subtract two two-digit numbers using a drawing or base-ten blocks.

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Then teams must ensure that their *teaching strategies* and *unit tasks* meet the level of thinking required in the *learning target*. One way to check this is to examine the *verbs* in the CCSS. When the standards use verbs like *understand, interpret*, or *choose* a level of accuracy, the mathematical tasks must be worthwhile and rich enough to get students thinking in this way. Finally, teams should be using *common, in-class formative assessments.* You can help teams develop appropriate *advancing* (moving beyond proficiency) and *assessing* (scaffolding for differentiation) formative questions to use in class (see p.5 of the summary in the sample lesson template). Below are two examples (at the fourth grade and high school level) of the key aspects of *implementing* the CCSS standards effectively (targets, strategies, tasks, and assessments):

Learning Target	Teaching Strategies	Common Tasks	Common Formative Assessment
Use models to represent and find sums involving fractions. (4th gr.)	Cooperative learning investigation followed by whole-class instruction	Students will use pictures, fraction bars, and number lines to investigate fraction addition.	Can all students add fractions with like denominators using models?
Determine if two triangles are similar. (HS)	Triangle lab in small groups	Students construct similar triangles using a pencil and paper and dynamic geometry software.	Can students correctly identify proportional relationships after identifying two triangles as similar?

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Chapter 4 – Leading the Implementation of the Teaching-Assessing-Learning Cycle

Notice that *assessing* appears in the middle of the teaching-assessing-learning cycle. In the traditional cycle of mathematics instruction, assessment comes at the end. But for students to truly attain the Common Core math standards, assessment – namely, formative assessment – must serve as a bridge between teaching and learning. Research shows that formative assessment has the power to dramatically improve student achievement and it is your job, as the leader, to make sure that formative assessment becomes an intense focus of each collaborative team.

In the same way that the Common Core math standards have called for a shift in the *content* and *instructional* approach in math, it also calls for a shift in *assessment* practices. First, assessment can no longer be an isolated teacher activity. Teachers need to *collaboratively* design in-class formative assessment tasks and questions as well as *collaboratively* examine assessment results. This will lead to less variation among mathematics teachers in a single school so all students can have access to the same, high-quality mathematics tasks and assessments. Not only does this minimize variance, but it provides greater continuity as the students transition into the next year of math. Furthermore, assessment can no longer serve primarily to report student achievement (summative assessment), but it must now be used formatively to continually *enhance* teaching and learning. So, how do you know if your teachers are effectively using formative assessments to improve student learning? You can use the following questions to help monitor the quality of each collaborative team's formative assessment practices:

- Does the team provide effective and timely feedback to students?
- Does the team actively involve students in assessment practices to engage them in their own learning?
- Does the team adjust their teaching practices based on the results of assessments?
- Does the team recognize the important influence formative assessment has on motivation and student achievement?

<u>The Steps of the Teaching-Assessing-Learning Cycle</u>

In the teaching-assessing-learning cycle, teams start by identifying the learning targets, mathematical tasks, and common formative assessments and common instruments that will be used in an upcoming unit. Next is the implementation stage when teachers use the formative assessment strategies during the tasks. After this, students must take action on teacher feedback from the in-class formative assessments. Then, students adjust and take action using the common assessment instruments' results. Finally, collaborative teams must use the assessment feedback in order to make crucial adjustments to instruction.

Before the unit, teams must come together to collaboratively design learning targets and rich mathematical tasks. They also need to develop common formative assessments. This includes common rubrics, common in-class questions, and common formative assessment instruments (from quizzes to white boards). Again, as the leader, how do you know if the team's approach to formative assessment is high quality? Below is a rubric that you as the leader can use to clarify your expectations for high-quality formative assessment (the goal is to attain fours on all categories):

Assessment Indicators	Description of Level 1	Levels 2 and 3	Description of Level 4
Emphasis on learning targets	Learning targets are unclear or absent	…	Learning targets are clear and connected to assessments
Time allotment	Few students can complete assessment in given time	…	Assessment can be completed in allotted time
Clarity of directions	Directions are missing or unclear	…	Directions are appropriate and clear
Clear and appropriate rubrics	Rubric is absent or does not match the task	…	Rubric is clear and appropriate for the task
Variety of assessment tasks	Only one type of assessment task	…	Variety of questions and assessment types
Questioning	Wording is vague or misleading and vocabulary imprecise	…	Vocabulary is direct and clearly understood. Students attend to precision
Balance of procedural fluency and understanding	Assessment emphasis is on procedural knowledge and is not high rigor	…	Assessment balances procedural and higher-order understanding

During the unit, teachers implement formative assessment strategies, teachers provide feedback, and students take action on that feedback. Research shows that formative assessment is an incredibly powerful tool – it can increase student achievement by 70 to 80 percent. For this reason it is crucial that teachers implement daily, in-class, formative assessments. There are a range of formative assessment strategies teachers can use, including: mini whiteboards, traffic lights or red and green disks, all-student response systems, and effective questioning techniques. It can be particularly effective when leaders help teams reach agreement on the formative assessment questions they will use in class. When these questions are designed well, it increases the likelihood that teachers will adjust their instruction accordingly. However, if students do not *act* on teacher adjustments and feedback, then the formative assessment becomes meaningless. Encourage teacher teams to think of ways to involve students in acting on the feedback they receive – either by having students identify their own strengths and weaknesses or setting goals for improvement. As the leader you don't necessarily need to know exactly *how* to do this, but do make sure that teams are planning ways for students to act on the feedback they receive.

After the unit the teaching-assessing-learning cycle is not complete until teams examine student assessment results and use it to adjust instruction for the next unit. This is also the time for the team to look back at the unit completed and to judge the quality of the formative assessment questions, the teacher feedback, the rubrics, and more in order to improve the unit for the next year.

What practices make grading effective?

A discussion of assessment practices wouldn't be complete without mentioning grading. As teams begin to shift their thinking about the use of assessment in mathematics, this is a good time to examine grading practices. In fact, mathematics teachers' traditional grading methods actually destroy motivation and learning. Research shows that once students view their grades, learning stops. As was described in this chapter, assessment should primarily be used formatively to enhance motivation and learning. Imagine using homework, quizzes, and tests in mathematics *only* as formative measures to help students improve. The authors challenge your collaborative mathematics teams to see how far into a semester they can go without assigning a specific grade to any assignment!

However, teachers often must assign grades for reporting purposes. Since this is the case, as the leader, make sure that teachers' grading practices are appropriate and effective (adapted from page 103).

- Grades must be **accurate**: Do grades on tests, quizzes, and assessments reflect actual student knowledge of the learning targets? Teams can work collaboratively to design common scoring rubrics and norm their grading by grading student work together and discussing discrepancies.
- Grades must be **specific:** Are grades specific enough to point students to the areas they need to improve long before a summative grade is assigned? Teams should not only design a rubric that conveys specific feedback to students, but they should agree on the weight of different items.
- Grades must be **timely:** Do students receive a steady flow of immediate feedback?
- Grades must be **fair:** Are grades based solely on student academic performance (and not on characteristics like lateness)? Are students given multiple attempts to master a learning target over time? Can students turn in work late or are they given a zero?

The collaborative team must engage in honest discussions about grading to determine if there is grading inequality across the team and whether teachers are using practices that may damage student motivation and learning. As a leader you, too, may have biases when it comes to grading. Explore the questions below about grading on your own and then use them to structure productive conversations with your math teams about their grading practices (adapted from page 107):

- List all the components (quizzes, homework, etc.) that go into your students' grades and the percentages you assign to each. How do these differ across the team?
- How do you deal with a "really bad F" (like a 39%)? Do you give out zeros? (Giving zeros demotivates students. Even really good grades are not enough to offset zeros so this takes away motivation to try.)
- What is your position on makeup work? Do you have a way to motivate students to continue to try even if they fail at first?

Chapter 5 –Leading the Implementation of Required Response to Intervention

As you read the Common Core State Standards for mathematics, a big question is whether we will be able to help *every* student succeed in meeting these standards. It's a challenge, but it is clear from the standards that *all* students must meet these standards, not just some of them. As the leader, it is your job to ensure that there is an *equitable* math program in which there are structures to provide *all* students with access to the same high-quality mathematics instruction.

To begin, you must define what equity in mathematics means for your staff. Equity means that all subpopulations of students have access to the same challenging, college-preparatory curriculum. Furthermore, it means that students in one math class receive the same high-quality math tasks as those in other classes. In addition, all students should have access to the same instructional resources, tools, and technologies as each other. By stressing that collaborative teams create *common* rich mathematical tasks, *common assessments*, do *collaborative* grading, and share other practices and approaches, this provides a more equitable math program for students.

In addition, as the leader it is your job to ensure that collaborative teams have a systematic approach to students not meeting the standards. When assessment data reveal that some students have gaps in their learning, rather than placing those students into lower-level math classes or groups, you must provide the time, support, and funding for those students to succeed. This is where Response to Learning (RTI) comes in. First, it is important to emphasize that providing students with necessary interventions to meet the standards is *not* optional and must occur during the school day. To make sure this happens, your RTI model should have the following tiers:

Tier 1: What is Your Differentiated *Response to Learning?* The first level is for *all* students and is really just an aspect of good teaching. This level occurs in the classroom and necessitates that teachers employ rigorous math tasks and high-quality instruction that includes differentiation, modeling, and scaffolding. Differentiation does not mean the content is made easier, but rather that there may be different entry points or ways for students to make sense of and demonstrate their learning. As the leader, you can help your teams *plan* for differentiation. This will help prevent the need for some students to receive more assistance.

Tier 2: What is Your Targeted *Response to Learning?*
Even after the scaffolding and differentiating in Tier 1, some students may still struggle with certain Common Core mathematics skills or understanding. Tier 2 interventions are intended just for these students, not for all. Examples of these interventions include small-group instruction in the math class, additional time outside of the regular math class, development of language proficiency to help with content knowledge, and more. You need to emphasize that the instruction that occurs as part of this intervention must look *different* from the instruction the students are receiving in the regular math class. Students who need additional interventions do not need more of the same thing!

Tier 3: What is Your Intensive *Response to Learning?*
Finally, Tier 3 interventions are for students who have multiple needs such as learning *and* behavior needs. These students may need inclusion classrooms, one-on-one tutoring, or tailored learning or behavioral interventions. What is important here is that students are not removed from their regular mathematics class in order to receive these additional interventions.

Collaborative teams must plan for these interventions and how they intend to monitor student progress and then communicate these plans to you, the leader. In particular, they should let you know how students will move in and out of their interventions.

EPILOGUE

While the new Common Core State Standards for mathematics certainly present educators with new challenges, they also provide for an unprecedented opportunity for math educators to rededicate themselves to providing *all* students with the highest quality math program and support to truly improve proficiency. In order to meet the new demands and respond to the required paradigm shifts in math instruction, use the overview below to assess the current practices at your school:

COLLABORATION	
Instruction • Deep conceptual understanding • Collaborative lesson-design tool • Standards for Mathematical Practice	**Content** • Fewer standards with greater depth • Understanding, focus, and coherence • Common and high-demand tasks
Intervention • Common required response to intervention • Differentiated, targeted, and intensive response to student needs • Student equity, access, and support	**Assessment** • Teaching-assessing-learning cycle • In-class formative assessment practices • Common assessment instruments

THE MAIN IDEA's PD suggestions for leaders and math teams

Some of the ideas below help leaders reflect on their own, some provide suggestions of what to look for in walkthroughs so leaders better understand what's currently happening with math instruction, and some are PD ideas to use with math teachers.

1. Self reflect on where you are in implementing the many roles outlined for the math leader

Throughout the book, the authors refer to "the leader's role" in implementing the CCSS for mathematics. I have compiled a list of some of those different roles below. Take a look at these roles and reflect on your own progress with each one:

• To provide a vision of what math tasks, questions, assessment, and learning should look like in the classroom
• To provide the structures, conditions, and culture necessary to shift from a focus on the individual teacher to the collaborative team
• To provide training and support for leaders of all collaborative math teams
• To ensure that mathematics collaborative teams are focusing on the *right*, high-leverage actions (common lessons, common assessments, common rigorous tasks, etc.)
• To ensure that the CCSS content standards are being implemented effectively (teachers *understand* them, have enough *time* to teach the content, use appropriate *technology*, and implement them as *intended* – with appropriate objectives, tasks, and assessments)
• To help teams change the way assessments are used so that teachers are using them more *formatively*
• To ensure that all math teachers understand the importance of equity in math and provide those students who struggle to reach the standards with a systematic approach to intervention

2. Have math teachers assess how collaborative their teams truly are

In their collaborative math teams, have teachers use the chart below to assess which stage of working together they believe they are in. Then have them discuss what they might need from the leader to support them in moving toward the *collaboration* level.

Level of Team Work	Stage	Questions That Define This Stage
COOPERATION	**Stage one**: Filling the time	What exactly are we supposed to do as a team?
	Stage two: Sharing personal practice	What is everyone doing in his or her classroom for instruction, lesson planning, and assessment?
	Stage three: Planning, planning, planning	What should we be teaching during this unit, and how do we lighten the load for each other?
COORDINATION	**Stage four**: Developing common assessments	How will we know if students learned the standards? What does mastery look like for the standards in this unit?
	Stage five: Analyzing student learning	Are students learning what they are supposed to learning? Do we agree on student evidence of learning?
COLLABORATION	**Stage six**: Adapting instruction to student needs	How can we adjust instruction to help those students struggling and those exceeding expectations?
	Stage seven: Reflecting on instruction	Which lesson-design practices are most effective with our students?

3. As the leader, do a walkthrough of all mathematics team meetings

How many of the teams are focusing on the high-leverage actions below? Which items are most teams addressing and which are being neglected? Alone or with your teams, choose one or two neglected areas for the teams to focus on in the upcoming months.

- The team agrees on prior knowledge to be assessed and the learning to be taught in the unit.
- The team agrees on lesson-design elements and ensures that CCSS Mathematical Practices are included in each unit.
- The team designs ways for students to demonstrate their learning in each lesson.
- The team designs agreed-on common assessments and implements common scoring and feedback.
- The team designs agreed-on adjustments to teaching and student support based on formative assessments.
- The team agrees on levels of rigor for classroom and homework tasks.
- The teams designs agreed-on methods to teach students to self-assess and set goals.

As the leader, do a walkthrough of math classes to determine if teachers are focusing on ***procedural*** or ***conceptual*** learning

With the CCSS students are expected to do more conceptual learning. Do a walkthrough of math classes to see how many focus on procedural fluency and how many focus instead on deeper understanding, reasoning, and problem solving. Do a simple tally:

# of Classes Focusing on Math Procedures	# of Classes Focusing on Math Concepts

***Note – If you want to do a more thorough walkthrough to see whether math teachers are implementing the Mathematical Practices, use the chart in the next section below to look for the subskills of the Mathematical Practices or use the Look-Fors chart from page 55 in the summary below:

Mathematical Practice	Look-Fors: Classroom Indicators
MP1: Make sense of problems, and persevere in solving them.	**Students:** Are engaged in problem solving and high-cognitive-demand tasks **Teacher**: Provides enough time and formative feedback for students to discuss problem solutions with peers
MP2: Reason abstractly and quantitatively.	**Students**: Are able to contextualize or decontextualize problems **Teacher**: Provides access to representations (manipulatives, drawings, etc.) of problems and asks questions to elicit reasoning
MP3: Construct viable arguments, and critique the reasoning of others.	**Students**: Use prior learning in constructing arguments **Teacher**: Provides opportunities for students to listen/read/hear the arguments of others and encourages them to question and provide their own arguments
MP4: Model with mathematics.	**Students**: Analyze and model relationships mathematically (eg., an expression or equation) **Teacher**: Provides contexts for students to apply math
MP5: Use appropriate tools strategically.	**Students**: Use instructional tools to deepen understanding (technology, manipulatives) **Teacher**: Provides and demonstrates appropriate tools
MP6: Attend to precision.	**Students**: Recognize need for precision and use appropriate math vocabulary **Teacher**: Emphasizes the importance of precise communication
MP7: Look for and make use of structure.	**Students**: Look for patterns and structure within mathematics **Teacher**: Provides time for students to discuss patterns and structure
MP8: Look for and express regularity in repeated reasoning.	**Students**: Reason about strategies and check for reasonableness of results **Teacher**: Encourages students to look for and discuss regularity in their reasoning

4. Structure conversations among math teachers about the 8 Mathematical Practices

Based on your walkthroughs, if you see a need for teachers to improve their implementation of the Mathematical Practices, then ask teams to discuss each of the eight Practices during team meetings using the two questions provided in the book:

1. What is the intent of this CCSS Mathematical Practice?
2. How can the collaborative team address this CCSS Mathematical Practice?

To help teachers address the issue of implementation in the second question, provide them with a list of the subskills to include in their classes in order to address all of the Mathematical Practices. How can they design lessons to incorporate these?

Subskills Needed for the 8 Mathematical Practices
• Students make conjectures about the meaning of a solution and plan an approach to the solution. (MP1)
• Students monitor and evaluate their progress and discuss this with peers. (MP1)
• Students understand multiple approaches and ask the question, "Does this solution make sense?" (MP1)
• Students communicate precisely using clear definitions when discussing their reasoning. (MP6)
• Students calculate accurately and efficiently using the appropriate units of measure. (MP6)
• Students can decontextualize a problem by representing a problem symbolically to solve it. (MP2)
• Students can contextualize a problem by attending to the meaning of the quantities involved in the problem. (MP2)
• Students make conjectures, explore the truth of those conjectures and justify and communicate their conclusions. (MP3)
• Students listen, read, and respond to the arguments of others for sense making and clarity. (MP3)
• Students represent mathematical concepts by using tools such as diagrams, tables, charts, graphs, calculators, and volume models. (MP4)
• Students use symbols and tools to represent real-world situations. (MP4)
• Students choose the appropriate tool for the task at hand. (MP5)
• Students know the limits of the tools they use for providing accurate solutions and can estimate reasonable solutions without the tool. (MP5)
• Students consistently search for the structure of mathematics. (MP7)
• Students engage in exploring numerical and visual patterns that reveal the structure. (MP7)
• Students notice and can articulate patterns that can become generalized properties or formulas. (MP8)

5. Help math teachers examine their own work – how well are they addressing the Standards for Mathematical Practice?

a) Ask teachers from each math team to bring a math problem they have used in class to a team meeting. Then have the team use the criteria from p. 3 of the summary to determine if each of these problems adequately addresses the Mathematical Practices. A sample problem might be: "Determine the distance between home plate and second base on a Major League Baseball field. Show all of your work and provide an explanation" (page 34).

- Is the problem *interesting* and *challenging* to students?
- Does the problem involve *meaningful* mathematics?
- Does the problem provide an opportunity for students to *apply* and *extend* mathematics?
- Does the problem allow for *multiple strategies* or multiple solutions?

b) Does each team have a bank of real-world problems they can draw from? If not, have each team use a meeting to look through newspapers, magazines kids like, popular blogs, etc. and use these real-world materials to begin to brainstorm real-world problems.

c) The Mathematical Practices require teachers use tools strategically. Have teachers think back to their last use of technology and judge how many of the following criteria it met? If it didn't meet any, or only one, have the team brainstorm ways to meet more criteria:

- To increase student *interactivity* with content.
- To increase *collaboration* and *discussion.*
- To *differentiate* content.
- To provide more *feedback* for students and teachers.

