CHAPTER 1

Using High-Performing Collaborative Teams for Mathematics

The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so that teachers and parents know what they need to do to help them learn. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. With American students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy.

—National Governors Association Center for Best Practices & Council of Chief State School Officers

The mission of the K–12 CCSS for mathematics is ambitious yet obtainable. To successfully implement the CCSS Mathematics Standards for High School, you need to be engaged in a meaningful process of implementation. Such a process allows you a rich opportunity to be engaged in effective and significant professional development and learning with your colleagues. The primary purpose of your collective and collaborative teamwork is to develop a coherent, ongoing unit-by-unit cycle of *teaching-assessing-learning* around the robust mathematics curriculum of the Common Core mathematics. This cycle (detailed in chapter 4) uses a collaborative approach of planning before a unit of instruction begins; collecting evidence of student learning needs before, during, and after the unit; interpreting that evidence in terms of mathematics practices and content; and shaping instruction to support student learning. Working together on activities within this cycle, you and your team have the opportunity to fulfill the expectations of the CCSS and, at the same time, build a supportive environment for the professional development of one another.

Research affirms the value of your collaboration with others and its positive impact on student achievement (Learning Forward, 2011). Many professional organizations include teacher collaboration as an essential part of professional growth and responsibility (Learning Forward, 2011; National Board of Professional Teaching Standards, 2010; National Council of Supervisors of Mathematics, 2007; National Council of Teachers of Mathematics, 1991, 2000). Whether you are a veteran or novice mathematics teacher, your participation in collaborative teams benefits student learning.

Just as students in groups need direction and support to work together well, high school teachers in collaborative teams need direction and support to effectively collaborate as well. This chapter defines and details how to create *collaborative teams* within a PLC. You will discover how to operate successfully as part of your team and learn the high-leverage collaborative actions that support the authentic implementation of the CCSS. Whether you are part of a new team or a veteran team with deep experience in the PLC process, this chapter helps you identify the current stage of your collaboration and the types of work and discussions in those stages, and it provides several critical collaborative protocols through which you can measure your team's continued progress.

The Professional Development Paradigm Shift

One of the reasons the CCSS have attracted so much attention and gained traction is the potential to address the prevalent concern that U.S. students have historically learned mathematics content in a superficial manner in which concepts and skills are approached as discrete and unrelated topics without application. As a high school mathematics teacher, how often have you heard from others or personally felt that you are obligated to reteach much of what students were supposed to have been taught the previous year?

Although great teaching does not look the same in every classroom, the Common Core standards expect you and your colleagues to commit to high-quality instruction as an essential element of successful student learning. Implementing the CCSS with fidelity requires you to not just teach mathematics content but to teach students processes and proficiencies for ways of thinking and doing mathematics—a habit of mind, so to speak. In the CCSS, these learning processes are referenced within the eight Mathematical Practices (see chapter 2) and the Standards for Mathematical Content (see chapter 3). Your participation in collaborative team discussions allows for the creation and implementation of a rigorous and coherent mathematics curriculum and prevents ineffective instructional practices. Implementing the CCSS for mathematics means you and your colleagues, working together in collaborative teams, must "balance personal goals with collective goals, acquire resources for [your] work, and share those resources to support the work of others" (Garmston & Wellman, 1999, p. 33). Kanold (2011a) explains it this way:

> This is the wonderful paradox of the loose-tight or "defined autonomy" leadership culture. . . . Adults can work within a defined set of behaviors [the CCSS expectations] *and* have an opportunity for freedom and choice. Autonomy is different from independence. Autonomy in the loose-tight PLC world does not mean the individualistic going it alone, relying on nobody. Yet as Daniel Pink (2009) points out, autonomy "means acting with choice—which means we can be both autonomous and happily interdependent with others." (p. 48)

The issue is not about protecting individual teacher autonomy. Rather, the issue is teaching and supporting your collaborative team autonomy with the tools necessary to collaboratively reflect and experiment in ways that are connected to the vision and

mission of your school district and the CCSS, supported by research, and that have direct impact on improved student learning.

At your high school, teachers and administrators might equate PLCs with teacher collaboration. As such, *PLC* is a fairly ubiquitous term in education. At the same time, various definitions and understandings regarding a PLC culture abound. In this book, we use the work of DuFour, DuFour, and Eaker's (2008) *Revisiting Professional Learning Communities at Work* and DuFour, DuFour, Eaker, and Many's (2010) *Learning by Doing* to define the conditions for collaborative mathematics learning teams in an authentic PLC school culture. For our purposes, we will refer to grade-level or course-level groups of faculty and resource staff working together in a PLC as *collaborative teams*.

Figure 1.1 lists the primary characteristics that define collaborative team expectations. These actions of shared visioning, collective inquiry, collaborative action, and continuous improvement are foundational to you and your team's ability to answer these four critical questions of a PLC as you implement the CCSS Mathematics Standards for High School.

1. What are the knowledge, skills, and dispositions we want all students to acquire as a result of their experience in our course? (See chapters 2 and 3.)
2. How will we know each student has acquired the intended knowledge, skills, and dispositions? What is our process for gathering information on each student's proficiency? (See chapter 4.)
3. How will our team and school respond to students who experience difficulty in acquiring the intended knowledge and skills? How will we provide them with additional time and support for learning in a way that is timely, directive, precise, and systematic? (See chapter 5.)
4. How will our team and school provide additional enrichment for students who are already proficient? (See chapters 2 and 5.)

Collaborative high school mathematics teams do the following:

1. Work toward a shared vision of mathematics curriculum, instruction, and assessment tied to the school and district vision as aligned with the Common Core standards' expectations
2. Engage in collective inquiry around rigorous mathematical practices and content, high-quality instruction, and formative assessment practices that provide meaningful feedback on student progress
3. Remain focused on a collaborative action orientation, experimentation, and reflection by all team members
4. Use assessment data to guide continuous and formative improvement of student learning and teacher instruction

Figure 1.1: High school collaborative team expectations and activities.

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You often work toward success for every student by yourself, without an articulated or shared image of what that might look like in a high school mathematics classroom. For example, if you asked each teacher on your team to list his or her top three non-discretionary teaching behaviors critical to student success, would the response reveal a coherent and focused vision for instruction from your team?

Similar to providing students with a learning target to aim toward, a first step for your collaborative teams is to create a shared vision of curriculum, instruction, and assessment specific to learning high school mathematics. As Danielson (2009) argues, "It's not sufficient for a school to be comprised of individual expertise; that expertise must be mobilized in the service of a common vision" (p. 17).

A shared vision is a necessary cornerstone to the work of your collaborative team. You might already have that vision for instruction and assessment in place, which is a good start. However, vision alone is not sufficient. Collaborative teacher inquiry, action orientation, experimentation, and reflection will enable you to make progress toward implementation of the vision. This brings an intentional purpose to your daily work. In many high schools, teachers are working in teams and using data to set goals and monitor student progress. Does this describe your work at your school? If so, this is important and necessary, but not sufficient if it is carried out in isolation from your colleagues.

Although given less attention, the difficult team*work* of collective inquiry together with action orientation and experimentation has a more direct impact on student learning (Hattie, 2009). It is in the process of inquiry and experimentation that you find meaning in your collaborative work with colleagues. It is through respectfully challenging your peers about what does and does not work in the classroom that you take ownership of your own beliefs, learning, and professional development.

Through the collective creation, modification, and ongoing reflection of what is taught and how instruction and assessment impact student learning, you begin to pursue your personal growth as a professional. When you and your collaborative team focus discussions on the mathematical content and processes students engage in and how instruction and formative assessment sustain meaningful student learning, your professional growth becomes continuous and embedded in your daily work, and your students' performance will soar. This book is designed to support your professional growth work as teachers and collaborators at your school.

Your collaboration with colleagues is about "purposeful peer interaction" (Fullan, 2008, p. 41). Purposeful peer interaction begins as you use a common vocabulary for your team discussions. It is an important factor contributing to your focused interactions with colleagues. The vocabulary and format of the CCSS Mathematics Standards for High School may be somewhat different from what you are accustomed to using. Figure 1.2 presents some key terms for the Common Core Mathematics Standards for High School, and the complete text for Common Core Mathematics Standards for High School is presented in appendix C (page 165).

The **conceptual categories** of the CCSS Mathematics Standards for High School are: Number and Quantity; Algebra; Functions; Modeling; Geometry; and Statistics and Probability. Each conceptual category consists of several domains, with the exception of Modeling.

Domains are larger groups of related standards. Standards from different domains may sometimes be closely related. For example, Number and Quantity has four domains (see appendix C, pages 165–169): the Real Number System (N–RN); Quantities (N–Q); the Complex Number System (N–CN); and Vector and Matrix Quantities (N–VM). An acronym accompanies each domain title.

Content standard clusters are groups of related standards. Note that standards from different clusters may sometimes be closely related because mathematics is a connected subject. The domain the Real Number System (N–RN) has two content standard clusters: (1) Extend the properties of exponents to rational exponents, and (2) Use properties of rational and irrational numbers.

Standards define what students should understand and be able to do. The two content standard clusters in the Real Number System domain include three standards: N–RN.1, N–RN.2, and N–RN.3.

1. Extend the properties of exponents to rational exponents
    - **N-RN.1:** Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.
    - **N-RN.2:** Rewrite expressions involving radicals and rational exponents using the properties of exponents.
2. Use properties of rational and irrational numbers.
    - **N-RN.3:** Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Source: Adapted from National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010, pp. 5, 60.

Figure 1.2: How to read the CCSS mathematics standards for high school.

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According to Reeves (2010), high-impact professional development and learning in collaborative teams is:

1. Focused on student learning
2. Focused on assessment of the decisions teacher team members make
3. Focused on people and practices rather than programs

Based on these features of collaborative teams, your professional learning takes place as your team discusses questions such as, How might we teach the Complex Number

System (N-CN) so students understand the concept of complex numbers? (see N-CN, appendix C, page 167). During the unit, your team collects and analyzes data to determine if your instructional decisions had an impact on student learning of complex numbers. In this process, your team attends to the needs of teachers by creating and supporting their collaborative work in the critical examination of student learning. Together, team members analyze student work and classroom practices and exchange ideas about mathematics content and the assessment of that content. This unit-by-unit cycle of dialogue with your peers results in a greater impact on student achievement and brings a focus and coherence to your work as a team.

Collaboration is not necessarily efficient or easy. However, when you and your peers have the skills and knowledge to collaborate through professional conversations focused on student learning, the dialogue, reflection, and actions that characterize your collaborative team emerge as a significant part of your ongoing professional learning. As Fullan (2008) indicates, your collaborative learning is the work.

Teacher Collaboration Versus Cooperation or Coordination

Without teacher collaboration, the Common Core Mathematics Standards for High School are merely another set of standards: "These standards are not intended to be new names for old ways of doing business. They are a call to take the next step" (NGA & CCSSO, 2010, p. 5). When you and your colleagues collaborate through discussion and dialogue about the impact of the CCSS on curriculum, instruction, and assessment, your content knowledge capacity will increase and you will develop effective ways to approach mathematics instruction—with pedagogical content knowledge.

The only sustainable form of mathematics professional development in high school occurs when you work in highly effective collaborative teams around issues of curriculum, instruction, and assessment (NCSM, 2008a; Learning Forward, 2011). Given the high stakes of increased academic achievement for students, your collaboration with peers becomes a nondiscretionary reality of your work, and the mathematics teachers in your high school should not be allowed to opt out of working with you and your peers when it comes to issues related to student learning.

The act of becoming an effective teacher can no longer be about *my students* or *your students*. It is about *our students* and what each teacher can do in the courses he or she teaches to benefit all students—including those students in need of the various and multiple RTI options discussed in chapter 5. Teachers accustomed to going into their classrooms, closing the door, and making decisions in isolation, separate from colleagues, are missing the opportunity to share their knowledge and experience with colleagues. If such individuals are in your school, they miss the chance to learn from others and lose out on the benefits of participation in a collaborative team. Taking advantage of opportunities to interact with your colleagues on matters of mutual interest and concern enables you to grow professionally.

Although teacher collaboration is an essential aspect of a PLC, what is often considered *collaboration* is actually cooperation or coordination. *Cooperation* is an informal process for sharing information with no goal or outcome in mind (Grover, 1996). Cooperation is about being a team player. One potential danger of cooperation is the exclusion of a diversity of team member ideas. Consider a scenario in which your team members share ideas and lesson plans about how they each teach a learning target about triangle congruence to geometry students. In this case, teachers cooperate by sharing resources, although each teacher retains his or her own authority to teach and assess the learning target as he or she best understands it.

Coordination, on the other hand, requires more planning and increased communication by the teacher team than does cooperation. Efficiency regarding the management aspects of the course tends to drive teachers to coordinate. For example, your Algebra 1 Team may coordinate a schedule so all teachers have access to graphing calculators for the unit on graphing linear equations, or it might divide up different content standards from a particular CCSS content standard cluster in order to design lessons for the team. Note that coordination can serve purposes of efficiency but do little to push peer inquiry and student discussion as part of the daily instruction and assessment in the classroom—the true purpose and high-leverage work of the high school collaborative teams in a PLC.

Whereas *cooperating* and *coordinating* are about individuals on the teacher team making decisions, *collaborating* is about creating interdependence with your colleagues as you work beyond consensus building. When your team is collaborating effectively, members are creating new structures and ways of working that are focused on academic success for all students, not just the students in their own classes. Graham and Ferriter (2008) offer a useful framework that details seven stages of collaborative team development. The level at which teams fall within Graham and Ferriter's framework is directly correlated to each team's level of effective collaboration. Table 1.1 highlights these seven stages.

Table 1.1: The Seven Stages of Teacher Collaboration Diagnostic Tool

Stage	Questions That Define This Stage
Stage one: Filling the time	What exactly are we supposed to do? Why are we meeting? Is this going to be worth my time?
Stage two: Sharing personal practice	What is everyone doing in his or her classroom? What are some of your favorite problems you use for this unit?
Stage three: Planning, planning, planning	What content should we be teaching, and how should we pace this unit? How do we lighten the load for each other?
Stage four: Developing common assessments	How do you know students learned? What does mastery look like? What does student proficiency look like?

continued →

Stage	Questions That Define This Stage
Stage five: Analyzing student learning	Are students learning what they are supposed to be learning? What does it mean for students to demonstrate understanding of the learning targets?
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 of our instructional and assessment practices are most effective with our students?

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Teams at the first three stages of collaborative team development are trying to understand what they are supposed to do and accomplish. Consider the following scenario. The Precalculus Team began meeting weekly at the beginning of the year with little direction as to the purpose of meeting (stage one). Shortly, the team began to share how each teacher approached conditional probability (S-CP, see appendix C, page 190) in his or her respective classrooms (stage two). By the end of the semester, the Precalculus Team began to discuss the homework problems that best represented what students should know and be able to demonstrate related to radian angle measure (F-TF.1, see appendix C, page 179) and had decided who would compile the assignment sheet to be distributed to students (stage three). At this stage, the precalculus teachers are *cooperating* as they begin to share their own classroom practices and delegate team responsibilities.

Teams in stages four and five are *coordinating* around common planning of instruction, developing common assessment instruments and tasks, and analyzing student learning results. An Algebra 2 Team (or a Mathematics 3 Team, if integrated course sequencing) comes together (stage four) to develop a common quiz to assess students' ability to solve rational and radical equations (A-REI.2, see appendix C, page 173). The following year, the Algebra 2 Team creates common assessment instruments for all course units or chapters and uses collaborative team time to analyze and compare results in order to determine how all algebra 2 students are performing on the learning standards for the course.

It is in the final two stages that teams are actually *collaborating* as members take collective responsibility for ensuring all students learn, differentiating instruction, and designing assessments based on student needs by reflecting on the question, Which practices are most effective with our students? (Graham & Ferriter 2008, p. 42). After analyzing the data from the unit's common assessment, a Geometry Team (or a Mathematics 3 Team, if integrated) has identified a small group of students struggling to apply some of the chord relationships in circles (G-C.2, see appendix C, page 186). The teams develop a differentiated re-engagement lesson to extend the knowledge and reasoning of students who have mastered the learning target and provide targeted support for struggling

learners (stage six). The Geometry Team will reach stage seven when team members regularly make adjustments to instruction using the teaching-assessing-learning cycle (described in chapter 4) based on learner needs and discuss instructional strategies that have the greatest impact on student learning.

You can use table 1.1 to determine your collaborative team's current stage of development and to consider what might be done to move to the next stage. In a mathematics department with several teams, you and your colleagues may be interested in comparing notes about issues other teams address and how they conduct their meetings. When your collaborative team works together, are discussions focused on sharing each teacher's lessons or activities without inquiry into assessing student learning? Are meetings centered on when the unit or chapter assessment instruments will be given in class, rather than whether or not the instrument is a high-quality exam? Is your focus mostly on scheduling or on how you and your colleagues are connecting the learning standards with context throughout the unit? Discussions with your team colleagues can help you determine whether the team is cooperating, coordinating, or collaborating.

Collaborative Practices

The goal of collaboration is deep, widespread knowledge of subject-area content and consistent implementation of best-practice instruction for that content. McKinsey and Company (Barber & Mourshed, 2007; Mourshed, Chijioke, & Barber, 2010) conducted two studies of the world's highest-performing school systems. According to these studies, the world's highest-performing school systems are able to "decrease the pedagogical variability between teachers and increase the quality of instruction. . . . They do this by establishing clear instructional priorities and investing in teacher preparation and professional development" (Barber & Mourshed, 2007, p. 12). The structure designed for collaborative efforts to support teachers in their professional learning is critical. Five aspects of collaborative practice can be considered:

1. Collaborative team participants
2. Collaborative team commitments
3. Collaborative team leaders
4. Collaborative team agendas and meeting minutes
5. Collaborative team time

In order to do the work of the team described in figure 1.1 (page 7) and to move effectively and efficiently to the more advanced stages of team collaboration, it is important that your team responds to each of these five collaboration factors.

Collaborative Team Participants

The needs, interests, and expertise of individual team members will often affect the flow and the work of your team. The members of your collaborative team may also vary according to the needs of your school or district. For larger schools, collaborative

teams may be comprised of all teachers of a particular course, subject, or grade level. For example, a collaborative team may be all teachers of advanced honors algebra, teachers of all levels of geometry, teachers of your mathematics 1 ninth-grade course, or all honors mathematics teachers. Your collaborative teams might also benefit from other faculty and staff members participating on your team, including faculty members from other departments and school support personnel, such as counselors, special needs or English learner (EL) teachers, or paraprofessional tutors.

Team members need only have a common curricular, instructional, and assessment focus about which to collaborate. While there is no ideal or magic number of teachers on a collaborative team, experience seems to suggest that teams much larger than seven or eight can be challenging (Horn, 2010). When your teams are too large, discussions become unwieldy and a few extroverted teachers can hijack participation, limiting other team members' voices. It is possible for larger teams to engage in productive dialogue; however, a higher level of facilitation will be required. Your mathematics department chairs or instructional leaders should also consider individual compatibility when determining assignments to collaborative teams. The ability to work with colleagues who understand how to share information and how to work with a positive attitude on various team projects is important. One way to nurture this expectation for becoming an effective contributor to the team is through the development of clear team commitments and behaviors.

Collaborative Team Commitments

Expectations for how collaboration looks and sounds need to be clearly and explicitly communicated. In *What Works in Schools*, Marzano (2003) identifies the necessity for collegiality. *Collegiality* is defined as the way teachers interact with each other in a manner that is professional. Roland Barth (2006) provides a description of collegiality.

> When I visit a school and look for evidence of collegiality among teachers and administrators—signs that educators are "playing together"—the indicators I seek are:
>
> 1. Educators talking with one another about practice
> 2. Educators sharing their craft knowledge
> 3. Educators observing one another while they are engaged in practice
> 4. Educators rooting for one another's success (p. 10)

Fullan and Hargreaves (1996) explain that professional behaviors include respect for one another, a willingness to share mistakes, and an openness to critique practices and procedures (as cited in Marzano, 2003). Sharing mistakes and being open to criticism can be daunting. Thus, teams need to establish norms or collective commitments of conduct and behavior if members are to work collaboratively in ways that promote a level of openness and vulnerability and the ability to play together.

The purpose of team collective commitments is to create a respectful, open environment that encourages diversity of ideas and invites criticism combined with close inspection of practices and procedures. Various protocols are available to assist you and your

team in establishing actions that team members agree to follow. The process need not be arduous, complicated, or time consuming. The protocol in figure 1.3 is one model your team can use to establish and review collective commitments throughout the year.

Setting Team Collective Commitments

Because we need our best from one another in working as a team, it is essential that we set collective commitments for our work cultures. Collective commitments are values and beliefs that will describe how we choose to treat each other and how we can expect to be treated.

As we set three to four collective commitments for ourselves, please note that establishing these does not mean that we are not already good people who work together productively. Having collective commitments simply reminds us to be highly conscious about our actions and what we can expect from each other as we engage in conversations about our challenging work.

Step one: Write three or four "We will" statements that you think will have the most positive influence on our group as we collaborate on significant issues about teaching and learning. Perhaps reflect on past actions or behaviors that have made teams less than productive. These are only a jumpstart for your thinking.

Step two: Partner with another colleague to talk about your choices and the reasons for your selection. Together decide on three or four commitments from your combined lists.

Step three: Move as a pair to partner with two to four other colleagues to talk about your choices and the reasons for your selection. Together decide on three or four commitments from your combined lists.

Step four: Make a group decision. Prepare to share your choices with the whole group.

Step five: Adopt collective commitments by consensus. Invite clarification and advocacy for particular commitments. Give all participants four votes for norm selection. It is wise not to have more than three or four.

Source: Adapted from P. Luidens, personal communication, January 27 and April 9, 2010.

Figure 1.3: Setting high school teacher team collective commitments protocol.

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Your high school team should keep collective commitments focused on behaviors and practices that will support the collaborative work of your team. Some teams find it useful to post their norms in a conspicuous place as a reminder to each other. Other teams might choose a commitment to highlight at each meeting as a reminder to the commitments of the team. For great advice and insight into collaborative team protocols, go to http://allthingsplc.info under Tools & Resources for additional ideas. Visit **go.solution-tree.com/commoncore** for links to additional resources.

As an example, members of a high school Algebra 2 Team decided their collective commitments would be to: (1) listen to understand, (2) challenge ideas, and (3) keep the focus on teaching and learning. Although the team included most of the same people as the previous year, team members reflected on the previous year and observed that sometimes one or two individuals passionate about their ideas often hijacked the

discussions without hearing others' ideas. The collective commitments reflect the collaborative team's dedication to hearing all ideas and respectfully challenging each other.

Each team member has the responsibility to hold one another accountable for the agreed-on commitments in a form of lateral or peer-to-peer accountability. To address team members for not adhering to the norms is a permissible and expected aspect of the team culture. Collaborative teams might find it useful to establish a collective commitment that addresses what happens when a commitment is not honored. The purpose of the collective commitments is to raise the level of professionalism and liberate the team to openly, safely, and respectfully discuss the work at hand. As collaborative teams grow and develop or change membership, collective commitments will likely change. Regardless of whether your collaborative team members change at the semester, you should revisit your collective commitments at the start of each semester every year.

Collaborative Team Leaders

Just as effective staff development doesn't happen without intentional planning and facilitating, collaborative team meetings also need intentional forethought and someone from your team to lead the group. The role of team leader or meeting facilitator might rotate or be delegated to one individual. On one hand, one person assigned team leader for the entire school year might bring continuity to your team discussions and functions. (A team leader may have other responsibilities related to the work of the team in addition to leading the team meetings.) On the other hand, perhaps rotating the role of team leader or meeting facilitator gives more of your colleagues the opportunity to take ownership and develop in their ability to facilitate discussions. To make the most of the collaborative meetings, the team leader's role should involve intentionally maximizing your group's ability to collaborate by inviting diversity of thought and challenging ideas and practices. An effective collaborative team always knows who is driving the meeting agenda and communicating the meeting outcomes. An effective high school mathematics team leader encourages all members to participate and ask each other questions to push for clarity and understanding. An effective team leader will also summarize team questions, understandings, decisions, and actionable items in a timely fashion.

Collaborative Team Agendas and Meeting Minutes

Designing time for mathematics collaborative teams is a considerable commitment of resources in people, money, and time. The payoff occurs when collaboration around teaching and learning mathematics results in professional growth and increased student achievement. Agendas and meeting minutes are tools that lend themselves to a more efficient use of time. The team leader is responsible for seeking input from team members, determining the agenda, and making the agenda public to the team a few days prior to the meeting. Agendas acknowledge that time is valuable and are essential to successful meetings (Garmston & Wellman, 2009). An agenda need not be complicated or long. Figure 1.4 provides a sample agenda from an Advanced Algebra Collaborative Team.

Tuesday, April 5

- Share and analyze results from the exponential unit assessment instrument (test).
  - How did our students do overall?
  - Were the results what we expected?
  - Which learning targets were the weakest overall performers for the students?
  - Did anyone's students do better on the weaker learning targets? What might this teacher have done different than the rest of us?
- Review learning targets for the logarithm unit.
  - Do our learning targets capture the key content concepts?
  - Do the learning targets together represent a balance of higher-level reasoning and procedural fluencies?
- Bring your best ideas for introducing logarithms for student exploration.
  - What have you tried in the past that seems to have worked?
  - Are there ideas, problems, or strategies that you have tried that didn't work?
  - What task or problem might we use to help students understand what a log is and how to better understand the log properties?

Figure 1.4: Sample team meeting agenda.

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Meeting minutes are beneficial and do not need to be overly detailed. Minutes serve many useful purposes. First, minutes for each meeting capture the actions and decisions that the team has made. Teams have found it helpful to go back to minutes earlier in the year or even to the previous year to recall discussions related to the ordering of content or why they decided to use a particular instructional approach for a concept. Minutes also capture who is responsible for various action steps, such as creating a scoring rubric and key for a quiz or test or arranging for copies of artifacts for all team members.

Notice that the minutes illustrated in figure 1.4 are quick bullet points that communicate the focus of the meeting so team members can come prepared with ideas, data, or other possible resources for the next meeting. Also note that the team leader provides guiding questions for team members to reflect on prior to the meeting. He or she primes the pump of expectations, so to speak. Team members can give prior thought and consideration to the topics, thus making the meeting more productive.

If you are like most high school teachers, you have anywhere from two to four different mathematics courses you teach each year. This means you serve multiple teams—creating a challenge to attend all team meetings. The minutes are also an efficient way to communicate to others what transpired at the meeting. So if you are unable to attend a meeting, you can use the minutes as a resource to see what was discussed and decided. Much like students absent from class, if you are absent from the meeting, you are still expected to know and carry out the decisions of the team. Technology is an effective

means by which to make minutes public to others. Minutes can be posted in an email, to a wiki, to a team blog, on a team website, or through cloud sharing.

The minutes also provide one form of communication to the mathematics department chairperson or the school mathematics administrator. The minutes allow school leaders to provide targeted guidance, direction, or resources to support the work of your collaborative team. Figure 1.5 is an example of a Geometry Honors Team's meeting minutes that were posted electronically. Notice how the meeting blends a balance of team procedural issues (when to give the formative cumulative exam based on the calendar) with team instructional issues (discontinuing the lab).

- After today's meeting, we are thinking about doing a variation of Val's social-emotional learning activity after the first quiz for the unit.
- We discussed how to deal with the shortened first-term grading period. We are thinking we should stay with the plan of giving the formative cumulative exam on the Monday after the grading period ends.
- We discussed ways to deal with properties of quadrilaterals rather than doing the lab. We are in favor of no longer doing the lab because it does not mirror the thought process we are trying to develop.
- We decided on partial credit for multiple-choice questions on tests and the formulas to use during all chapter 12 assessments.
- We decided to focus the formative assessment work in this unit on student communication and conjecturing with each other (Mathematical Practice 3).

Figure 1.5: Sample team meeting minutes.

Visit **go.solution-tree.com/commoncore** for a reproducible version of this figure.

Laying the groundwork for collaboration by articulating both the expectations of how your collaborative team will work together (toward constructive discussions and decision making) and the logistics of announcing and capturing your team discussions is essential. Attention to these fundamental team management issues supports deeper and more meaningful discussions that will impact student learning of mathematics. Once expectations have been articulated about collaboration, you and your team can engage in meaningful discussions around teaching and learning mathematics.

Collaborative Team Time

First and foremost, as a high school mathematics teacher, you need adequate time in order to achieve the expectations of ongoing weekly mathematics professional development. Reeves (2009) asserts it is a myth that people love to collaborate. He notes that real and meaningful collaboration takes time and practice and requires accountability: "Schools that claim, for example, to be professional learning communities but fail to provide time for collaboration are engaging in self-delusion" (p. 46). School district leaders sincere in their efforts to create a PLC will help you find creative ways to build time into the schedule for collaboration.

Figure 1.6 provides a few ideas to make your collaborative team professional development time a priority (Bowgren & Sever, 2010; Loucks-Horsley, Stiles, Mundry, Love, & Hewson, 2009).

1. Provide common time by scheduling most team members, if not all, the same period free from teaching during the day.
2. Create an altered schedule for early-release or late-arrival students on an ongoing basis.
3. Use substitute teachers throughout the day to release different collaborative teams for two to three hours at a time.
4. Occasionally release teachers from a teaching duty (such as one class period) or other supervision in order to collaborate with colleagues on a daily basis.
5. Restructure time by permanently altering teacher responsibilities, the teaching schedule, the school day, or the school calendar.
6. Purchase teacher time by providing monetary district compensation for weekends and summer work.

Figure 1.6: Options for scheduling teacher collaboration time.

Visit **go.solution-tree.com/commoncore** for a reproducible version of this figure.

Yet in order for your district or school to make a commitment to time, your school leaders must know that the team time will be focused on high-leverage professional development activities that will result in improved student learning for your course.

High-Leverage Professional Development

Just as students are not empty vessels waiting to be filled with mathematical knowledge and ways of reasoning, you and your team members bring myriad resources to the table—content knowledge, pedagogical knowledge, beliefs about teaching, classroom experiences, and personal experiences (Raymond, 1997). While the impact of these prior knowledge factors cannot be ignored, the team's collaborative efforts can influence some of these attributes in your colleagues. Based on what is known about adult learning and professional growth, professional development programs should emphasize building teachers' pedagogical content knowledge (Loucks-Horsley et al., 2009). You can engage in these programs; however, teachers don't have the authority to create the programs. School and district leaders are responsible for creating on-site professional development learning opportunities for teachers, built around developing and implementing teaching strategies specific to the CCSS content being taught. The collaborative efforts of district and school leaders and teachers will have a positive impact of student learning.

The CCSS Mathematics Standards for High School (see appendix C, page 165) provide a vision and verification tool of the content to be taught that can be used to challenge you and your colleagues as you reflect on your beliefs and practices about teaching mathematics. As you collaborate, your beliefs about teaching and learning become revealed. Through discourse in your teams, you and your colleagues articulate beliefs

and expectations and seek to reconcile inconsistency of ideas and practices in the quest to continuously improve student mathematics learning and creating greater equity in the student learning experience. This ongoing process of sharing, questioning, and reconciling ideas culminates in professional learning that in turn brings about more equity and access for all students learning mathematics in the courses you teach.

Collaborative teamwork centered on developing student processes and proficiencies (the CCSS Standards for Mathematical Practice), meaningful student understanding of the content (CCSS content standard clusters within the domains of the high school curriculum), and development of assessment protocols (the CCSS consortia assessment framework expectations) result in ongoing, continuous, and embedded professional learning opportunities for you and your colleagues. Meaningful collaboration is built around high-leverage, high-inquiry collaborative team tasks, such as the ten listed in figure 1.7.

PLC Collaborative Teacher Team Agreements for Teaching and Learning

1. The team designs and develops agreed-on prior-knowledge skills to be assessed and taught during each lesson of the unit or chapter.
2. The team designs and implements agreed-on lesson design elements that ensure students actively engage with the mathematics. Students experience some aspect of the CCSS Mathematical Practices (such as construct viable arguments and critique the reasoning of others or Attend to precision) with the language embedded in the daily lessons of every unit or chapter.
3. The team designs and implements agreed-on lesson design elements that allow for student-led summaries and demonstrations of learning the daily lesson.
4. The team designs and implements agreed-on lesson design elements that include the strategic use of tools—including technology—for developing student understanding.

PLC Collaborative Team Agreements for Assessments Instruments and Tools

1. The team designs and implements agreed-on common assessment instruments based on high-quality exam designs. The collaborative team designs all unit exams, unit quizzes, final exams, writing assignments, and projects for the course.
2. The team designs and implements agreed-on common assessment instrument scoring rubrics for each assessment in advance of the exam.
3. The team designs and implements agreed-on common scoring and grading feedback (level of specificity to the feedback) of the assessment instruments. Two team members together grade a small sample of student work to check on consistency in scoring and grading feedback.

PLC Collaborative Team Agreements for Formative Assessment Feedback

1. The team designs and implements agreed-on adjustments to instruction and intentional student support based on the results of both formative daily classroom assessments and the results of student performance on unit or chapter assessment instruments, such as quizzes and tests.

2. The team designs and implements agreed-on levels of rigor for daily in-class prompts and common high-cognitive-demand tasks used to assess student understanding. This also applies to team agreement to minimize the variance in rigor and task selection for homework assignments and expectations for makeup work. This applies to depth, quality, and timeliness of teacher descriptive formative feedback on all student work.
3. The team designs and implements agreed-on methods to teach students to self-assess and set goals. Self-assessment includes students using teacher feedback, feedback from other students, or their own monitoring and self-assessment to identify what they need to work on and to set goals for future learning.

Figure 1.7: High-leverage actions of high school mathematics collaborative teams.

Visit **go.solution-tree.com/commoncore** for a reproducible version of this figure.

You can use figure 1.7 as a diagnostic tool to measure the focus of the work and energy of your team. The items in the figure can help you determine the level of implementation—high or low—for each of the team actions. Meaningful implementation of the CCSS will require time—time to digest the CCSS Mathematics Standards for High School, time to create a focused and coherent curriculum, and time to design instruction and assessments around the actions listed in figure 1.7.

Collaborative Protocols

Several protocols combine collaboration with a spotlight on the teaching and learning of mathematics. Five structured protocols can be especially beneficial for you and your team. These protocols provide different settings in which you can collaborate and share reflections and beliefs about teaching and learning.

1. **Lesson study:** Lesson study differs from lesson planning. Lesson study focuses on what teachers want students to learn; lesson planning focuses on what teachers plan to teach. A lesson study example is shown in the feature box on page 22.
2. **Peer coaching:** Peer coaching is a kind of partnership in which two or three teachers engage in conversations focused on their reflections and thinking about their instructional practices. The discussions lead to a refinement and formative assessment response to classroom practice. The participants may rotate roles—discussion leader, mentor, or advocate. Teachers who engage in peer coaching are willing to reveal strengths and weaknesses to each other. Peer coaching creates an environment in which teachers can be secure, connected, and empowered through transparent discussions of each others' practice.
3. **Case study:** Case study can be used to address a wide range of topics or problems the collaborative team encounters. The case study presents a story—one involving issues or conflicts that need to be resolved through analysis of available resources leading to constructive plans to address the problem. Typically,

case studies are used to examine complex problems—the school's culture, climate, attendance, achievement, teaching, and learning (Baccellieri, 2010).

4. **Book study:** Book study is a familiar and popular activity for teachers to engage in conversations with colleagues about professional books. It may be a formalized activity for some collaborative teams; however, book study can emerge in any number of ways—from hearing an author speak at a conference, from a colleague's enthusiastic review of a book, or from the mutual interests of teachers who want to learn more about a topic. Book study promotes conversations among faculty and staff that can lead to the application of new ideas in the classroom and improvement of existing knowledge and skills. Book study is a great way to connect with a personal learning network as you blog, tweet, Skype, or use other forms of communication to connect with colleagues outside of your school.
5. **Collaborative grading:** Collaborative grading occurs as your team reaches stages four and five (see table 1.1, page 11) of team collaboration. In this situation, you and your colleagues design a common unit test together and assign point values with scoring rubrics for each question on the exam. Together you grade and discuss the quality of student responses on the assessment instrument and develop an inter-rater reliability for scoring of the assessment tool. Achieving consistency in grading students' assignments and assessments is an important goal for collaborative teams.

From the point of view of instructional transparency and improvement, lesson study is a particularly powerful collaborative tool that merits close consideration. Lesson study has been shown to be very effective as a collaborative protocol with a high impact on teacher professional learning (Hiebert & Stigler, 1999).

Example of a Lesson-Study Group in Action

Typically, teachers choose a content area that data indicate is problematic for students. Consider a lesson-study group that develops a goal related to the CCSS Mathematical Practices (see appendix B, page 161). The teachers select Mathematical Practice 1 as the goal—students will learn to make sense of problems and persevere in solving them. They share ideas about how to help students achieve this goal through the content of the lesson. The teachers select content from the CCSS domains and content standard clusters that presents a particular challenge to students. In this case, the group chooses "understand that polynomials form a system analogous to the integers" (A-APR.1, see appendix C, page 172). The teachers use various resources to learn more about the content and its connections to other mathematical concepts, as well as about information from research about student learning of operations with polynomials. From those resources, the teachers together designed a lesson to address the goal. One team member was asked to teach the lesson and be observed by one or two other members of the team. The teacher who taught the lesson and the observers debriefed the team about their observations and made changes to the lesson design. The revised lesson was taught with a final debriefing of the

second instructional episode. By the end of the lesson study, these teachers have increased their knowledge of pedagogy and mathematics content. By contributing to development of the lesson and engaging in discussions of the lesson's strengths and limitations, they have also raised the level of respect and trust among team members. The lessons learned from participating in lesson study extend to the teachers' daily instruction.

Lesson study may seem time and work intensive for a single lesson. Nonetheless, the benefit of lesson study is the teacher professional learning that results from the deep, collaborative discussions about mathematics content, instruction, and student learning. See the lesson-study references listed in the Extending My Understanding section at the end of this chapter (page 24) for more information about this powerful activity for stages six and seven (see table 1.1, page 11).

Looking Ahead

Your collaborative team is the key to all students successfully learning the Common Core Mathematics Standards for High School through effective instruction, assessment, and intervention practices. In subsequent chapters, we'll provide tools to assist you and your colleagues' work to make the vision of the Common Core for mathematics a reality for all students. In regard to the administrator's role in this process, the National Board for Professional Teaching Standards (2010) states:

> Seeing themselves as partners with other teachers, they [administrators] are dedicated to improving the profession. They care about the quality of teaching in their schools, and, to this end, their collaboration with colleagues is continuous and explicit. They recognize that collaborating in a professional learning community contributes to their own professional growth, as well as to the growth of their peers, for the benefit of student learning. Teachers promote the ideal that working collaboratively increases knowledge, reflection, and quality of practice and benefits the instructional program. (p. 75)

Highly accomplished mathematics teachers value and practice effective collaboration, which professional organizations have identified as an essential element to teacher professional development (Learning Forward, 2011; National Board for Professional Teaching Standards, 2010). Teacher collaboration is not the icing on top of the proverbial cake. Instead, it is the egg in the batter, holding the cake together. Your school is a learning institution responsible for educating students and preparing them for the future. Your school is also a learning institution for the adults. The professional learning of teachers is not solely a prerequisite for improved student achievement. It is a commitment to the investment in the professionals, like you, who have the largest impact on students in schools. The process of collaboration capitalizes on the fact that teachers come together with diverse experiences and knowledge to create a whole that is larger than the sum of the parts. Teacher collaboration is *the* solution to your sustained professional learning —the ongoing and never-ending process of growth necessary to meet the classroom demands of the CCSS expectations.

Chapter 1 Extending My Understanding

1. A critical tenet of a mathematics department of a PLC is a shared vision of teaching and learning mathematics.
    - Do you have a shared vision of what teaching and learning mathematics looks like? If not, how might you create one?
    - Does this vision build on current research in mathematics education?
    - Does your vision embrace collaboration as fundamental to professional learning?
2. Graham and Ferriter (2008) identify seven stages of collaborative team development. These stages characterize team development evolving from cooperating to coordinating, leading ultimately to a truly *collaborative* team.
    - Using table 1.1 (page 11), at what stage are your teams operating?
    - What role might you play in helping your team transition to a more advanced stage?
3. Using figure 1.7 (page 21), identify the high-leverage actions your team currently practices extremely well. What is your current level of implementation on a scale of 0 percent (low) and 100 percent (high)? How might you use this information to identify which actions should be your team's priority during this or the next school year?
4. Implementing the CCSS content and Mathematical Practices might seem daunting to some teachers, and as a result, there may be resistance or half-hearted attempts to needed changes in content, instruction, or assessment. Consider leading your collaborative team through a Best Hopes, Worst Fears activity. Give team members two index cards. On one, have them identify their best hopes for implementing the CCSS. On the other card, have team members record their worst fears. Depending on the level of trust and comfort of the team, the team leader might collect the index cards and read the best hopes and worst fears anonymously or individuals can read their hopes and fears aloud to the group. The purpose is to uncover concerns that, left covered, might undermine collaborative teamwork. Team members should talk about how they can support one another to minimize fears and achieve best hopes.
5. Choose a collaborative protocol (pages 21–22) that you are either familiar with or would like to learn more about. How might that protocol be used to engage your collaborative team in a discussion of implementing the CCSS content and Mathematical Practices?

Online Resources

Visit **go.solution-tree.com/commoncore** for links to these resources. Visit **go.solution-tree.com/plcbooks** for additional resources about professional learning communities.

- *The Five Disciplines of PLC Leaders* **(Kanold, 2011a; go.solution-tree.com/plcbooks/Reproducibles_5DOPLCL.html):** Chapter 3 discusses the commitment to a shared mission and vision by all adults in a school for several tools targeted toward collaborative actions. These reproducibles engage teachers in professional learning and reflection.
- **Chicago Lesson Study Group (www.lessonstudygroup.net/index.php):** This website provides a forum for teachers to learn about and practice lesson study to steadily improve student learning. To learn more about lesson study or other collaborative protocols, see the following resources.
  - *Lesson Study: A Handbook of Teacher-Led Instructional Change* (Lewis, 2002)
  - *Powerful Designs for Professional Learning* (Easton, 2008)
  - *Leading Lesson Study* (Stepanek, Appel, Leong, Managan, & Mitchell, 2007)
  - *Data-Driven Dialogue: A Facilitator's Guide to Collaborative Inquiry* (Wellman & Lipton, 2004)
- **AllThingsPLC (http://allthingsplc.info):** Search the Tools & Resources of this website for sample agendas and activities for collaborative work.
- **The Educator's PLN—the Personal Learning Network for Educators (http://edupln.ning.com):** This website offers tips, tools, and benefits for starting your own PLN.
- **The Center for Comprehensive School Reform and Improvement (2009; www.centerforcsri.org/plc/websites.html):** This website offers a collection of resources to support an in-depth examination of the work of learning teams.
- **Inside Mathematics (2010b; www.insidemathematics.org/index.php/tools-for-teachers/tools-for-principals-and-administrators):** This portion of the Inside Mathematics website supports school-based administrators and district mathematics supervisors who are responsible for establishing the structure and vision for the professional development work of grade-level and cross-grade-level learning teams or in a PLC collaborative team.
- **Learning Forward (2011; www.learningforward.org/standards/standards.cfm):** Learning Forward is an international association of learning educators focused on increasing student achievement through more effective professional learning. This website provides a wealth of resources, including an online annotated bibliography of articles and websites, to support the work of professional learning teams.
- **The National Commission on Teaching and America's Future (NCTAF, 2006; www.nctaf.org/NCTAFReportNSFKnowledgeSynthesis.htm):** With the support of the National Science Foundation and in collaboration with

WestEd, NCTAF (2006) released S*TEM Teachers in Professional Learning Communities: From Good Teachers to Great Teaching*. NCTAF and WestEd conducted a two-year analysis of research studies that document what happens when science, technology, engineering, and mathematics teachers work together in professional learning communities to improve teaching and increase student achievement. This report summarizes that work and provides examples of projects building on that model.

- **Learning by Doing: A Handbook for Professional Communities at Work (DuFour et al., 2010; go.solution-tree.com/PLCbooks/Reproducibles_LBD2nd.html):** This resource and its reproducible materials help educators close the knowing-doing gap as they transform their schools into professional learning communities.
- **The Mathematics Common Core Toolbox (www.ccsstoolbox.org):** This website provides coherent and research-affirmed protocols and tools to help you in your CCSS collaborative teamwork. The website also provides sample scope and sequence documents and advice for how to prepare for CCSS for mathematics implementation.