

## CHAPTER 1

# Before the Unit

*Teacher: Know thy impact.*

—John Hattie

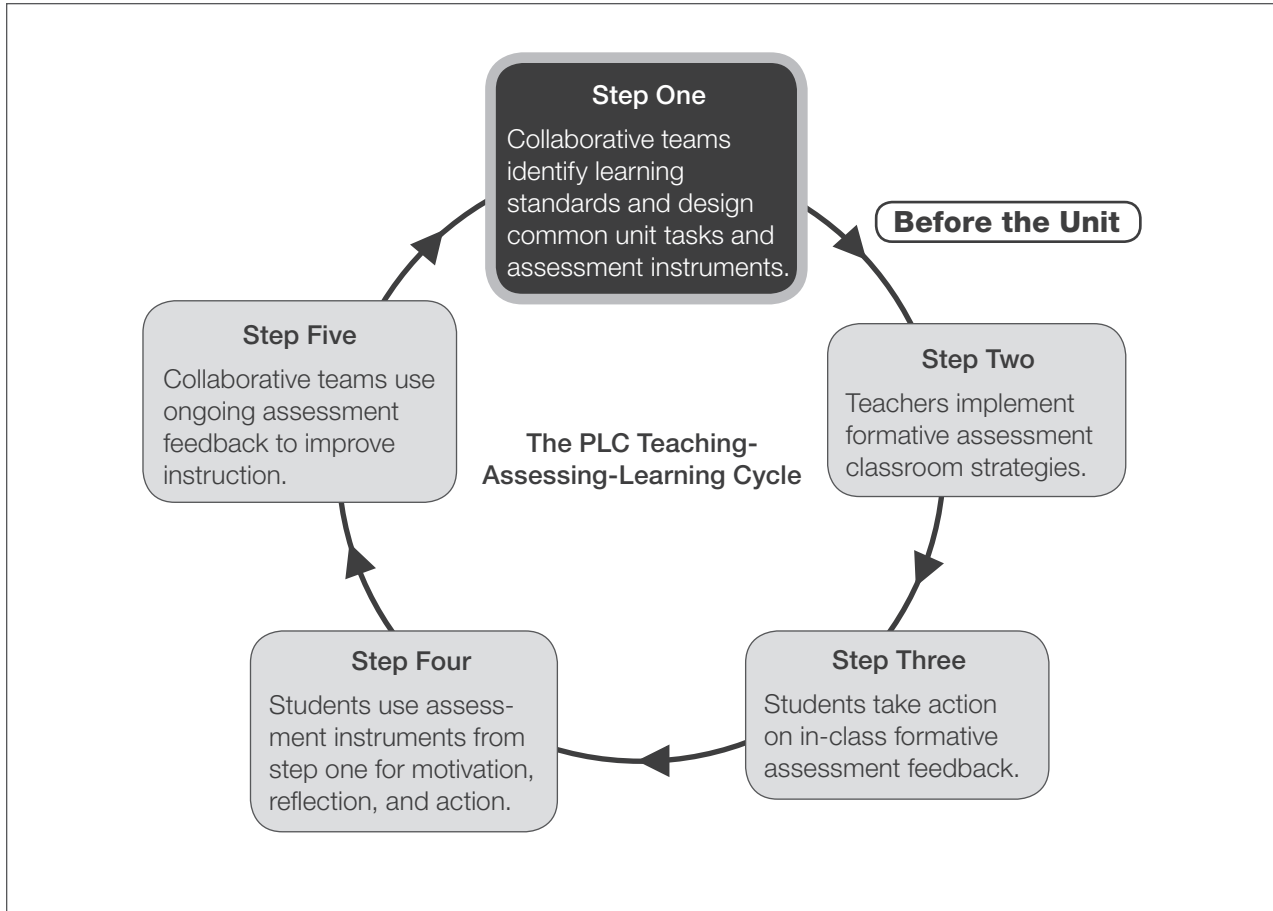
As a school leader, you are and always will be a teacher—of adults. Thus, the Hattie quote that opens this chapter is for you too. What will be your impact on the adults in your school or district, every month, every day, and on every unit of instruction? The ultimate outcome of before-the-unit planning is for your teachers to develop a clear understanding of the shared expectations for student learning during the unit. Do you expect a teacher learning culture that understands mathematics as an effort-based and not an ability-based discipline? Do you have high expectations that every teacher can ensure all students learn?

Your collaborative teams, in conjunction with district mathematics curriculum team leaders, prepare a roadmap that describes the knowledge students will know and be able to demonstrate at the conclusion of the unit. To create this roadmap, each collaborative team prepares and organizes work around five before-the-unit high-leverage team actions that you will need to monitor.

- HLTA 1. Making sense of the agreed-on essential learning standards (content and practices) and pacing
- HLTA 2. Identifying higher-level-cognitive-demand mathematical tasks
- HLTA 3. Developing common assessment instruments
- HLTA 4. Developing scoring rubrics and proficiency expectations for the common assessment instruments
- HLTA 5. Planning and using common homework assignments

These five team pursuits are based on step one of the PLC teaching-assessing-learning cycle (Kanold, Kanold, & Larson, 2012) shown in figure 1.1 (page 10). This cycle drives your pursuit of a meaningful formative assessment and learning process for your teacher teams and for your students throughout each unit of instruction during the year.

In this chapter, we describe each of the five before-the-unit teacher team actions in more detail (the what) along with suggestions for how to achieve these pursuits (the how). Each HLTA section ends with an opportunity for you to evaluate the current reality for your teams (team progress). The chapter ends with time for reflection and action (setting your Mathematics at Work priorities for team action).



Source: Kanold, Kanold, & Larson, 2012.

**Figure 1.1: Step one of the PLC teaching-assessing-learning cycle.**

# HLTA 1: Making Sense of the Agreed-On Essential Learning Standards (Content and Practices) and Pacing

*An excellent mathematics program includes curriculum that develops important mathematics along coherent learning progressions and develops connections among areas of mathematical study and between mathematics and the real world.*

—National Council of Teachers of Mathematics

For most grade levels (K–8) or courses (9–12) there will be eight to twelve mathematics units (or chapters or modules) during the school year. How do you help your collaborative teams develop their understanding for each of the agreed-on and essential mathematics learning standards for the units throughout the year—especially when the mathematics content may not be your area of expertise? You can help by asking for and monitoring several key collaborative team artifacts.

Recall there are four critical questions every collaborative team in a PLC asks and answers on an ongoing unit-by-unit basis.

1. What do we want all students to know and be able to do? (The essential learning standards)

2. How will we know if they know it? (The assessment instruments and tasks teams use)

3. How will we respond if they don't know it? (Formative assessment processes for intervention)

4. How will we respond if they do know it? (Formative assessment processes for extension and enrichment)

High-Leverage Team Action	1. What do we want all students to know and be able to do?	2. How will we know if they know it?	3. How will we respond if they don't know it?	4. How will we respond if they do know it?
Before-the-Unit Action				
HLTA 1. Making sense of the agreed-on essential learning standards (content and practices) and pacing	<div></div>			

 = Fully addressed with high-leverage team action

This first high-leverage team action enhances teacher clarity on the first PLC critical question: What do we want all students to know and be able to do?

## The What

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### Real-Life Leadership Scenario

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*We were working with a grade-level team on the essential standards for the unit teachers were about to teach. In an offhand remark to the team, I [Tim] said, “Well, of course everyone on the team teaches to the same standards, right? This became expected practice back in the late 1980s.” A few team members started to giggle. When I asked them what was funny, they indicated that there was one member who rarely taught the expected standards and that she wasn’t there today. I asked, “Well, how is she allowed to do that?” They answered that it had always been that way; she was just different. I asked if they saw the inequity this caused for students, and they indicated that yes, they did, but the group became uncomfortable, so we moved on. I made a note to talk to the principal about the matter as soon as possible. I wondered, too, what the principal would actually do to help the team resolve this inequity in student learning.*

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The essential learning standards for the unit—the guaranteed and viable mathematics curriculum—include *what* (content standard clusters and standards) students will learn, *when* they will learn it (the pacing of the unit), and *how* they will learn it (often via process standards such as the Common Core Standards for Mathematical Practice or other state-designed process standards). The Common Core Standards for Mathematical Practice “describe varieties of expertise that mathematics educators at all levels should seek to develop in their students” (National Governors Association Center for Best Practices [NGA] & Council of Chief State School Officers [CCSSO], 2010, p. 6). Following are eight Standards for Mathematical Practice, which we include in full in appendix A (page 131).

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning. (NGA & CCSSO, 2010, pp. 6–8)

Every teacher and teacher team you lead must be tight about teaching to the essential learning (content and process) standards for the unit. The answer to the first critical question (What do we want all students to know and be able to do?) is not optional or a choice for each teacher to make individually. Your role, then, is to monitor and ensure every course-based or grade-level team member receives the professional development, instruction, engagement, and confidence necessary to teach each essential standard for the unit well.

A unit of mathematics instruction connects topics in mathematics that are naturally grouped together—the essential ideas or content standard clusters. Each of those units (sometimes called *chapters*, *modules*, or both depending on your state, district, or curriculum) should consist of about four to six essential learning standards every student of the course is expected to learn. This is considered the optimal grain size for all of your assessment and analysis work as a teacher team. Too many standards per unit become overwhelming for teachers. Too few, and teachers cannot focus student learning and their support. Four to six total essential learning standards for the unit are just right.

A simple step would be to ask the team to show you *how* this is being done. Ask your teams to show you the number of essential learning standards they are teaching for a current unit. Does the grain size of their focus make sense to you? If not, advise them to revise and adjust the number of essential learning standards for the unit.

Do all team members agree on the essential learning standards, and do you have evidence they are teaching to those standards? If not, be clear about your essential learning standard expectations for *all* teachers on the team.

Although the essential learning standards for the unit might be developed as part of a district curriculum task force, your collaborative teams should take time during lesson-design discussions to make sense of the essential standards (for example, you could always ask a team to explain to you how it is making sense of an essential standard for the unit and to provide you with a mathematics task or example that represents that standard).

As your collaborative teams unpack the content standards (or your district's essential learning standards), it is also important for them to decide which Mathematical Practices or processes make mathematical sense to engage students throughout the unit of instruction and as part of each lesson. *Unpacking*, in this case, means making sense of the mathematics listed in the standard, making sense of how the content connects to content learned in other mathematics courses as well as within the current course, and making sense of how students might develop both conceptual understanding and procedural skill with the mathematics listed in the standard.

Thus, throughout the year, you can always ask a teacher or team, “For today’s mathematics lesson, can you explain to me the essential learning standard *and* the essential Mathematical Practices or process standard I should expect to see the students doing? How will students demonstrate understanding?”

More detail on implementing Mathematical Practices and processes as part of lesson design is provided in HLTA 6 on page 63.

## The How

How can you help your teams unpack the content and link it to student practices for any unit, especially if mathematics is not your core discipline of understanding? You can help your teacher teams by

providing them with the time necessary for deep discussions about the meaning of the essential learning standards *before* the unit begins and by actively monitoring the results of those team discussions.

### ***Teams Make Sense of the Essential Learning Standards***

A key outcome of this first high-leverage team action is for your teachers to personally and collaboratively make sense of the essential learning standards with an eye toward planning for student engagement in the Mathematical Practices that support them. This needs to occur *before* the unit begins for teachers to take full advantage of their instructional time and effort during the unit.

At Stevenson High School District 125, a PLC school district, school leaders (including the lead author of this handbook, Tim Kanold, who was the director of mathematics and the superintendent) were required to ask the teachers for evidence that they were using national resources in their work. They needed to address how national thought leaders and expert organizations were informing local practice. Your collaborative teams may need your help securing outside resources to make sense of the mathematics involved in the learning standards within a unit. Reading the background information in your school textbook or digital teacher's editions can be a good source for this foundational knowledge, as can resources from the National Council of Teachers of Mathematics ([www.nctm.org](http://www.nctm.org)), such as the *Essential Understanding* series.

In general, you can monitor and support HLTA 1 by asking each team to use figure 1.2 as a discussion tool during the year as teachers break down the major essential learning standards for student understanding in each unit.

This is a form you can ask teams to complete for each unit and *turn in to you for your review*.

However, there is one caveat: you must review the completed form and provide feedback (good or bad) to the teacher team. Otherwise, the team will view completion of the form as a perfunctory exercise and not take it seriously.

Figure 1.2 offers one way for you to collect evidence of your teams' discussions on this important high-leverage team action. When unpacking the essential learning standards through these types of questions, your collaborative teams develop understanding of the essential learning standards, including daily learning objectives, the prerequisite knowledge and vocabulary needed, and the appropriate Mathematical Practices to support student learning.

### ***Teams Make Sense of the Content Progressions for the Unit***

You should also ask each team to provide you with a unit calendar that shows the essential learning standard progression of the unit. Figure 1.3 (pages 16–17) provides a sample eighth-grade geometry unit. By viewing the calendar, you know the approximate pacing of the unit, how many days (lessons) are spent on each essential learning standard, when the unit ends, interventions you might need to support during and after the unit, and questions that might arise from the broader school community, including parents.

**Directions:** Work with your collaborative team to unpack the essential learning standards and the associated Mathematical Practices relevant to the current unit of study for your grade level or course.

Teacher team:

Name of unit:

1. List the agreed-on essential learning standards for this unit.
2. What is the prerequisite knowledge needed to engage students with each essential learning standard?
3. What is the time frame available to teach this unit, and how will that time be distributed for each essential learning standard?
4. What are the mathematics vocabulary and literacy skills necessary for student success in this unit?
5. What are specific teaching strategies, tasks, and tools that will most effectively support each essential learning standard for the unit?
6. Which Mathematical Practices or processes should be highlighted during the unit in order to better engage students in the process of understanding each learning standard?
7. Identify the specific lessons that will highlight mathematical modeling for the standards of the unit.

**Figure 1.2: Discussion tool for making sense of the agreed-on essential learning standards for the unit.**

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Unit Plan: Twenty Instructional Days				
Day 1	Day 2	Day 3	Day 4	Day 5
<b>8.G.1:</b> I can verify experimentally the properties of rotations, reflections, and translations. Exploration Using Geometry Software Students will manipulate shapes through translations and reflections to make conjectures about their observations.	<b>8.G.1:</b> I can verify experimentally the properties of rotations, reflections, and translations. Exploration Using Geometry Software Students will manipulate shapes through rotations to make conjectures about their observations.	<b>8.G.1:</b> I can verify experimentally the properties of rotations, reflections, and translations. Informal Assessment Students create a transformation to prove the properties of transformations.	<b>8.G.1:</b> I can verify experimentally the properties of rotations, reflections, and translations. Students will engage in a final vocabulary activity using the Frayer Model to finalize understanding about the properties of transformations.	<b>8.G.2:</b> I can demonstrate the congruence of two-dimensional figures using the properties of rotations, reflections, and translations. Students will discuss congruence and begin creating congruent figures through translations.
Day 6	Day 7	Day 8	Day 9	Day 10
<b>8.G.2:</b> I can demonstrate the congruence of two-dimensional figures using the properties of rotations, reflections, and translations. Students will explore congruent figures that are reflected over the x-axis and y-axis.	<b>8.G.2:</b> I can demonstrate the congruence of two-dimensional figures using the properties of rotations, reflections, and translations. Students will explore congruent figures that are reflected over other lines.	<b>8.G.2:</b> I can demonstrate the congruence of two-dimensional figures using the properties of rotations, reflections, and translations. Students will explore rotations of shapes and identify if they are congruent.	<b>8.G.2:</b> I can demonstrate the congruence of two-dimensional figures using the properties of rotations, reflections, and translations. Students will create rotations that result in congruent figures and noncongruent figures using physical models and geometry software.	<b>8.G.2:</b> Informal Assessment I can demonstrate the congruence of two-dimensional figures using the properties of rotations, reflections, and translations. Students will create a sequence of transformations for a peer to decide if they are congruent.

continued ↓



Day 11	Day 12	Day 13	Day 14	Day 15
<b>8.G.3:</b> I can describe the effect of translations, rotations, and reflections on two-dimensional figures using coordinates. Students will apply their knowledge of transformations and learn how to use coordinates to describe a transformation or a series of transformations.	<b>8.G.3:</b> I can describe the effect of translations, rotations, and reflections on two-dimensional figures using coordinates. Students will apply their knowledge of transformations and learn how to use coordinates to describe a transformation or a series of transformations.	<b>8.G.4:</b> I can demonstrate that two figures are similar by using the properties of dilations, rotations, reflections, and translations of two-dimensional figures. Students will begin to explore the meaning of similar figures and the difference between similar and congruent.	<b>8.G.4:</b> I can demonstrate that two figures are similar by using the properties of dilations, rotations, reflections, and translations of two-dimensional figures. Students will discuss how two figures can be similar using reflections and translations. They will examine examples and nonexamples.	<b>8.G.4:</b> I can demonstrate that two figures are similar by using the properties of dilations, rotations, reflections, and translations of two-dimensional figures. Students will discuss how two figures can be similar using rotations, reflections, and translations. They will examine examples and nonexamples.
Day 16	Day 17	Day 18	Day 19	Day 20
<b>8.G.3 (Part 2):</b> I can describe the effect of dilations on two-dimensional figures using coordinates. Students will explore the effect of dilations on coordinates for two-dimensional figures using models and geometry software. Students will establish generalizations about effects.	<b>8.G.3 (Part 2) and 8.G.4:</b> I can describe the effect of dilations on two-dimensional figures using coordinates. Students will continue building their knowledge of dilations and how to represent the effect of a dilation using coordinates through various tasks.	<b>8.G.4:</b> I can describe a sequence of transformations between two figures that exhibits the similarity between them. Students will be given and will create a sequence of transformations between two figures and describe the sequence.	<b>Review for Unit 1</b> Students will combine all standards together.	<b>Assessment for Unit 1</b>
<b>Notes for Unit 1</b> When working through each standard, we may not need to break up the learning targets by each transformation; however, it may also help students to take an in-depth look at each transformation. This is something we will monitor throughout the unit and make notes on for next year. Also, 8.G.1 will continue to be embedded throughout instruction in this unit. Before moving on to similarity, we will ensure all students have a solid understanding of congruence and how it relates to transformations. Most work and dialogue during this unit will occur in teams of four. Students will present their thinking and listen to the thinking and reasoning of others to fully develop their understanding and their demonstration for the overarching unit, Mathematical Practices 1, “Make sense of problems and persevere in solving them,” and 4, “Model with mathematics.”				

*Note: Crossed-out text indicates that only a certain portion of the standard is the focus.*

*Source: Adapted with permission from Aptakic-Tripp CCSD 102, Buffalo Grove, Illinois.*

*Source for standards: NGA & CCSSO, 2010, pp. 55–56.*

**Figure 1.3: Sample unit progression for eighth-grade geometry.**

Visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this figure.

This first high-leverage team action is both a district *and* a teacher team responsibility. The district office does need to provide guidance to principals, leaders, and teachers as to the proper scope and sequence of the essential learning standards of the unit to ensure a guaranteed and viable curriculum that addresses student mobility issues.

You can't take away from team members the real work they must do; if you take away the work, you take away the learning. Your course- or grade-based team members need to be clear on the intent of the essential learning standards, the rationale for teaching the standards in a specific order, and the nuances of the meaning and intent of each essential standard.

At a minimum, you can expect your teams to write a set of unit notes using the questions provided in figure 1.2 on page 15 (and turn those notes in to you) as they work to better understand the intent of the mathematics content, the mathematics content progressions, and the overarching Standards for Mathematical Practice for that unit. Make sure you are connected to the electronic posting of all unit notes.

## Team Progress

It is helpful to diagnose the collaborative team reality and action prior to launching any unit. You can ask each team to assess its progress for HLTA 1, making sense of the agreed-on essential learning standards (content and practices) and pacing, by using table 1.1. It matters less which stage your teams are at and more that team members are committed to working together to focus on understanding the essential learning standards and the best mathematical tasks and strategies for increasing student understanding and achievement as teams seek stage IV—sustaining.

As your teams unpack the essential learning standards, they also need to identify and prepare for higher-level-cognitive-demand mathematical tasks related to those essential learning standards. It is necessary for them to include tasks at varying levels of demand during instruction. The idea is to match the tasks and their cognitive demand to the essential learning standard expectations for the unit. Selecting mathematical tasks together is the topic of the second high-leverage team action, HLTA 2.

**Table 1.1: Before-the-Unit-Begins Status Check Tool for HLTA 1—Making Sense of the Agreed-On Essential Learning Standards (Content and Practices) and Pacing**

<b>Directions:</b> Discuss your perception of your team’s progress on the first high-leverage team action—making sense of the agreed-on essential learning standards (content and practices) and pacing. Defend your reasoning.			
<b>Stage I: Pre-Initiating</b>	<b>Stage II: Initiating</b>	<b>Stage III: Developing</b>	<b>Stage IV: Sustaining</b>
We do not discuss the essential learning standards of the unit prior to teaching it.	We discuss and reach agreement on the four to six essential learning standards for the unit.	We unpack the intent of each essential learning standard for the unit and discuss daily learning objectives to achieve each essential standard.	We connect the four to six essential learning standards to the Mathematical Practices before the unit begins.
We do not know which essential learning standards other colleagues of the same course or grade level teach during the unit.	We discuss and share how to develop student understanding of the essential learning standards during the unit.	We collaborate with our colleagues to make informed decisions about instruction of the essential learning standards for each lesson in the unit.	We have procedures in place to review the effectiveness of the students’ roles, activities, experiences, and success on the essential learning standards during the unit.
We do not discuss lesson tasks.	We connect and align some lesson tasks to the essential learning standards for the unit.	We share effective teaching strategies for the essential learning standards of the unit.	We have procedures in place that ensure our team aligns the most effective mathematical tasks and instructional strategies to the content progression established in our overall unit plan components.
We do not discuss Mathematical Practices and processes as part of our unit planning.	We discuss Mathematical Practices and processes that best align to the essential learning standards for the unit.	We agree on Mathematical Practices and processes that best align to the learning standards for the unit.	We implement Mathematical Practices and processes that best align to the learning standards for the unit.

Visit [go.solution-tree.com/mathematicsatwork](https://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this table.



## HLTA 2: Identifying Higher-Level-Cognitive-Demand Mathematical Tasks

*The function of education is to teach one to think intensively and to think critically.*


—Martin Luther King Jr.

The mathematical tasks and activities your teachers and teacher teams choose to use each day and for every unit are the backbone for effective student learning. If you do not monitor those choices, they can often be a source of deep inequity in your school or district. The daily math problems or tasks your teachers use for student learning should not be made in isolation from their colleagues. The daily mathematical tasks chosen by your teacher teams each day represent how they answer the first critical question of a PLC: *What do we want all students to know and be able to do?*

The mathematical tasks and activities teachers choose each day also partially answer the second PLC at Work critical question for collaborative teams, *How will we know if they know it?* The nature of the mathematical tasks your teachers choose—higher- or lower-level cognitive demand—is as essential to student learning as the content and the process standards chosen for the unit.

High-Leverage Team Action	1. What do we want all students to know and be able to do?	2. How will we know if they know it?	3. How will we respond if they don't know it?	4. How will we respond if they do know it?
Before-the-Unit Action				
HLTA 2. Identifying higher-level-cognitive-demand mathematical tasks				

 = Fully addressed with high-leverage team action

 = Partially addressed with high-leverage team action

### The What

#### Real-Life Leadership Scenario

*I [Tim] was meeting with a high school geometry team in Southern California. At the team meeting, we were taking a close look at the type of mathematics problems (tasks) teachers would be using in class the next day. This being a geometry class, working on geometry standards, I was expecting some pretty exciting student investigations through the use of some higher-level-cognitive-demand tasks. I asked the teacher team two very simple questions.*

1. “How do you decide each day which mathematical tasks you will use to teach the standards for the lesson?”
2. “How will you ensure there is a balance of higher- and lower-level-cognitive-demand tasks used for student exploration and learning?”

*The teachers responded, “What do you mean by mathematical task and cognitive demand? We use the mathematics problems like the ones in our book, so our students will be ready for homework. Our students don’t really do the harder stuff; we are mostly trying to get them through the course. You will understand better*

*after you hang around the school for the next few months. This is a pretty tough neighborhood."*

*I asked the teachers on the team if they were getting help from their department chair, and one of the teachers said she was the department chair, and mentioned to me it was her suggestion to focus only on what the students could do and not that harder stuff. I took a deep breath and dove in wondering to whom in the administration I could go next to guide the teacher team and the entire department toward a more student-engaged approach via the tasks chosen. If it wasn't to be the department chair, then who? Who could the principal turn to for access to Hattie's (2012) research summary that supports teaching problem solving as a way to enhance basic skill development in students?*

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What is a mathematical task?

NCTM first identified the term *mathematical task* in its (1991, 2007) *Professional Teaching Standards* as "worthwhile mathematical tasks" (p. 24). Melissa Boston and Peg Smith (2009) later provide this succinct definition: "A mathematical task is a single complex problem or a set of problems that focuses students' attention on a specific mathematical idea" (p. 136).

Mathematical tasks include activities, examples, or problems to complete as a whole class, in small groups, or individually. The tasks provide the rigor (levels of complex reasoning from the conceptual understanding, procedural fluency, and application of the tasks) that students require and thus become an essential aspect of your teams' collaboration and discussion. In short, the tasks are the problems your teachers choose to determine the pathway of student learning and to assess student success along that pathway. Your teachers are empowered to decide what and how a student learns through their choice and the use of the mathematical tasks and activities that students experience. As Glenda Lappan and Diane Briars (1995) state:

There is no decision that teachers make that has a greater impact on students' opportunities to learn and on their perceptions about what mathematics is than the selection or creation of the tasks with which the teacher engages students in studying mathematics. (p. 139)

The selection of worthwhile mathematical tasks is so critical that it is one of the eight research-informed instructional strategies listed in *Principles to Actions* (NCTM, 2014). A key collaborative team decision, then, is to decide which tasks to use in a particular lesson or unit to help students attain the essential learning standards. A growing body of research links students' engagement in higher-level-cognitive-demand tasks to overall increases in mathematics learning, not just in the ability to solve problems (Hattie, 2012; Resnick, 2006).

Higher-level-cognitive-demand lessons or tasks are those that provide "opportunities for students to explain, describe, justify, compare, or assess; to make decisions and choices; to plan and formulate questions; to exhibit creativity; and to work with more than one representation in a meaningful way" (Silver, 2010, p. 2). In contrast, lessons or tasks with only lower-level cognitive demand are "characterized as opportunities for students to demonstrate routine applications of known procedures or to work with a complex assembly of routine subtasks or non-mathematical activities" (Silver, 2010, p. 2).

Take caution: selecting a task with higher-level cognitive demand does not ensure students will engage in rigorous mathematical activity (Jackson, Garrison, Wilson, Gibbons, & Shahan, 2013). The cognitive

demand of a mathematical task is often lowered (perhaps unintentionally) during the implementation phase of the lesson (Stein, Remillard, & Smith, 2007). Thus, during the planning phase before the unit begins, your teams should discuss how they would respond when students urge them to lower the cognitive demand of the task during the lesson. Supporting productive struggle in learning mathematics is one of the eight research-informed mathematics teaching practices outlined in *Principles to Actions* (NCTM, 2014). Strategies to avoid cognitive decline during task implementation are discussed further in chapter 2 (page 63, HLTA 6).

You can help your teacher teams by asking them to respond to several mathematical task questions before each unit begins and then turn in those responses to you. Remember, a major part of your work is to know what the teacher teams are doing, and to take action that both validates (supports) their work and provides feedback for improvement (accountability) as needed.

1. How do we define and differentiate between higher-level-cognitive-demand and lower-level-cognitive-demand tasks for each essential standard of the unit?
2. How do we select common higher-level-cognitive-demand and lower-level-cognitive-demand tasks for each essential standard of the unit?
3. How do we create higher-level-cognitive-demand tasks from lower-level-cognitive-demand tasks for each essential standard of the unit?
4. How do we use and apply higher-level-cognitive-demand tasks for each essential standard during the unit?
5. How will we respond when students urge us to lower the cognitive demand of the task during the implementation phase of the lesson?

Visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) to download these questions as a discussion tool.

You can also support your teacher teams in this work by expecting them to define, identify, and create higher-level- and lower-level-cognitive-demand tasks and to prepare for the use of higher-level-cognitive-demand tasks during each unit.

## The How

A critical step in selecting, planning, and eventually using higher-level-cognitive-demand mathematical tasks in class is for your collaborative teams to use designated team time to work the task before giving it to students. Working the task together should be an expected agenda item as each team provides information about possible solution strategies or pathways that students might demonstrate. When you take a look at the minutes or agendas of your teams' meetings, be sure to look for evidence of discussions about the math tasks they are using in class.

### *Defining Higher- and Lower-Level-Cognitive-Demand Mathematical Tasks*

Your teachers choose mathematical tasks for every lesson, every day. Take a moment to describe how they do this part of their work. Do they make those decisions alone, with team members, before the unit begins, or the night before they teach the lesson? Where do they locate the mathematical tasks? From the textbook? Online? From district resources? Sit in on a team meeting, and ask them these questions.



Most importantly, how would you describe the rigor of the mathematical tasks your teachers are choosing for your students? Rigor is not whether a mathematical task or problem is considered hard. For example, “Find the tangent  $5\pi/6$ ,” “Find  $2^{-3}$ ,” or “What is  $6 \times 7$ ” might be hard for some, but they are not rigorous tasks. *Rigor of a mathematical task* is defined in this handbook as the level and the complexity of reasoning the student requires during the task (Kanold, Briars, & Fennell, 2012). A more rigorous version of the latter task might be something like, “Provide two different ways to determine  $6 \times 7$  using facts you might know.” There are several ways to label the demand or rigor of a task; however, for the purposes of this handbook, tasks are classified as either lower-level cognitive demand or higher-level cognitive demand as defined by Smith and Stein (1998) in their task-analysis guide and printed in full as appendix C (page 139). *Lower-level-cognitive-demand tasks* are typically focused on memorization or performing standard or rote procedures without attention to the properties that support those procedures (Smith & Stein, 2011).

*Higher-level-cognitive-demand tasks* are tasks for which students do not have a set of predetermined procedures to follow to reach resolution or, if the tasks involve procedures, they require that students provide the justification for why and how the procedures can be performed. Smith and Stein (2011) describe these procedures as “procedures with connections” (p. 16) as opposed to “procedures without connections,” the designation they use for lower-level-cognitive-demand tasks that are not just based on memorization.

Figure 1.4 shows the two levels of cognitive demand and the four categories within the levels.

#### **Lower-Level Cognitive Demand**

*Memorization:* Requires eliciting information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula.

*Procedures without connections:* Requires the engagement of some mental processing beyond a recall of information.

#### **Higher-Level Cognitive Demand**

*Procedures with connections:* Requires complex reasoning, planning, using evidence, and explanations of thinking.

*Doing mathematics:* Requires complex reasoning, planning, developing, and thinking most likely over an extended period of time.

Source: Smith & Stein, 2012.

**Figure 1.4: Four categories of cognitive demand.**

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In all likelihood, the majority of the daily mathematical tasks your teachers choose are of the lower-level-cognitive-demand variety. You should find out if this is true for your teacher teams or not. For many teachers, there is a natural drift toward lower-level mathematical tasks. Lower-level-cognitive-demand tasks take less time in class and do not require much complex reasoning by students. They often contain one most efficient pathway and do not require student demonstration of multiple solution pathways. The efficiency of lower-level-cognitive-demand tasks is appealing. They are much easier to manage in class as a general rule and easily serve direct instruction from the front of the room. Mathematical content and practice standard expectations require students to demonstrate *understanding*. This requires a shift to a more *balanced* task approach during the unit—the use of both higher- and lower-level-cognitive-demand tasks. In most classrooms, this will require an increase in the use of higher-level-cognitive-demand tasks.

You can use figure 1.5, an example of a higher-level-cognitive-demand task, to help your teachers demonstrate understanding of the criteria for higher-level cognitive demand. Use the four questions in the task as a guide.

<b>Standard:</b> I can understand the meaning of equivalent expressions.			
Look at each expression. Is it equivalent to $\frac{x + 3y}{2}$ ?	<b>A.</b> $\frac{4x + 3y}{8}$	<input type="radio"/> Yes	<input type="radio"/> No
	<b>B.</b> $\frac{5}{4} \left( \frac{2x + 6}{5} \right)$	<input type="radio"/> Yes	<input type="radio"/> No
	<b>C.</b> $\frac{1}{2} (x + 3y)$	<input type="radio"/> Yes	<input type="radio"/> No
	<b>D.</b> $\frac{2}{3} \left( \frac{5x}{6} + \frac{9y}{4} - \frac{x}{12} \right)$	<input type="radio"/> Yes	<input type="radio"/> No
Select Yes or No for expressions A–D.			
Explain why each choice (A, B, C, and D) is equivalent or why it is not equivalent.			
<b>Directions:</b> Find a solution pathway to the problem by yourself first, and then discuss the mathematics task with your collaborative team.			
<div>1. How are your collaborative team members' responses the same? How do they differ?</div> <div>2. How does this task (and your solution pathway to the task) support the essential learning standard for equivalent expressions, and what is the prerequisite knowledge needed for the task?</div> <div>3. How does this task meet the criteria for higher-level cognitive demand?</div> <div>4. Which Mathematical Practices or processes might students engage while solving this higher-level-cognitive-demand mathematical task?</div> <div>5. Where might students get stuck when trying to work on this task together?</div>			

Source for the task: Smarter Balanced Assessment Consortium, 2013a. Used with permission.

**Figure 1.5: Sample higher-level-cognitive-demand task discussion tool.**

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Mathematical tasks such as those described in figure 1.5 determine student understanding and reasoning. Good higher-level-cognitive-demand mathematical tasks will contain elements such as multiple entry points to the tasks (lots of ways a student could enter into the problem), multiple solution pathways (lots of ways a student could reason to a solution), and require more complex levels of reasoning beyond just finding the one “right” answer. This is the nature of good higher-level-cognitive-demand mathematical tasks.

### ***Identifying the Cognitive Demand of the Daily Mathematical Tasks Teachers Use in Your School***

Ask your grade-level or course-based teacher teams to provide the percentage of higher- to lower-level-cognitive-demand tasks they present to their students throughout the unit, along with examples of these for the unit’s essential standards. You should expect teachers to roughly use a ratio of 3:1 lower-level-cognitive-demand tasks to higher-level-cognitive-demand tasks for each lesson during the unit. If this is the case for each daily lesson, it should at least be the ratio used for the balance of the unit.

As a first step in understanding the balance of current cognitive-demand levels of the mathematical tasks teachers use each day, ask your teachers to complete figure 1.6 for at least two standards of a future unit.

<b>Name of the Unit:</b> For at least two of the essential standards in this unit, provide samples of the types of mathematical tasks students will experience in class, for homework, or on assessments.	
<b>Directions:</b> Sort every task you use into the following four categories.	
Lower-Level Tasks	Higher-Level Tasks
<b>Memorization</b>          	<b>Procedures With Connections</b>          
<b>Procedures Without Connections</b>          	<b>Doing Mathematics</b>          

**Figure 1.6: Tool for sorting unit tasks by cognitive-demand level.**

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One way you can often judge whether a mathematical task is of higher cognitive demand (or not), even if you have a limited mathematics background, is to examine the differences in what a student is expected *to do* during the task.

Since student work should be balanced with respect to the level of cognitive demand across tasks, it is important for teachers to identify expected levels of cognitive demand and ultimately adapt or create tasks for each essential learning standard in the unit as the standards progress over time.

### ***Creating Higher-Level-Cognitive-Demand Tasks***

Higher-level-cognitive-demand tasks are essential for improving student achievement in mathematics. There are many resources online and in print that can provide examples of higher-level-cognitive-demand tasks for use in class. See appendix D (page 141), go to [nctm.org](http://nctm.org), or visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) for a list of resources.

However, you should expect each of your teams to also learn how to *create mathematical tasks* of varying cognitive demand together (remember if you take away the *doing* of this work from the team, you take away teachers' learning). This will empower greater ownership and understanding of mathematical task design and selection by the teachers on the team.

There are several strategies you can use to change a lower-level-cognitive-demand mathematical task to higher-level cognitive demand. You can ask your teams to use the strategies in figure 1.7 to adjust a mathematical task from lower-level cognitive demand to higher-level cognitive demand.

1. Use comparison questions. (When is one situation greater than, equal to, or less than another?)
2. Ask a question across multiple representations in a task.
3. Validate a solution pathway or approach.
4. Require students to provide justifications for (explain) their solutions.
5. Evaluate the error or reasoning in a student solution and provide a correct solution pathway.
6. Create a context. Ask students to write a word problem that creates a context for the given information.
7. Ask students to determine an expression to represent a situation.
8. Create an open-ended debate-type task, so that multiple student responses will satisfy a solution to the mathematical task.

**Figure 1.7: Strategies for increasing the cognitive demand of tasks.**

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You should expect your teams to use the discussion tool in figure 1.8 often. It will help them to become efficient with the process of increasing the cognitive demand of the tasks they chose for each unit. From time to time, you can ask them to complete this form and turn it in to you at the end of their meeting.

**Essential learning standard for the unit:**

Find one lower-level-cognitive-demand task you have used for this essential standard in the past. Using one of the task-modification strategies from figure 1.7, rewrite the task at a higher level of cognitive demand. List both the lower- and the higher-level-cognitive-demand task below.

Lower Level	Higher Level

Justify the cognitive-demand level of each task above, and then prepare to discuss with your team. Answer the following questions with your collaborative team.

1. How might what you learn about your students’ understanding of the essential learning standard differ depending on the cognitive demand of the task you use during instruction?
2. What strategy helped you write the higher-level-cognitive-demand task? Explain.
3. In what ways will you support the implementation of the higher-level-cognitive-demand task during instruction?

**Figure 1.8: Team discussion tool for identifying higher-level-cognitive-demand tasks for a unit.**

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Before teachers on your collaborative teams use any higher-level-cognitive-demand task in class, each team should:

- Discuss its expectations for *student demonstration of quality work* in defense of the mathematical argument for the task (What will teachers expect to be a solution pathway?)
- Discuss how the lesson plan for the problem will be well-managed and promote communication of student argument with others and allow peer-to-peer–based solution defense

To help your collaborative teams facilitate this type of discussion, expect them to use figure 1.9 for any common higher-level-cognitive-demand task.

### ***Preparing for the Use of Higher-Level-Cognitive-Demand Tasks***

Once your teams include identifying and creating higher-level-cognitive-demand mathematical tasks as part of their unit planning, the before-the-unit activity will likely change. Your teachers will begin to look at mathematical tasks and problems, classify them as higher-level or lower-level cognitive demand, and then decide on the best points of entry during the unit for the higher-level-cognitive-demand tasks. The implementation and use of these tasks during the unit are discussed in further detail in chapter 2 in HLTA 6 (page 63).

<p><b>Directions:</b> Use these questions to better understand how you will use any higher-level-cognitive-demand task in class.</p>
<p>What is the essential standard for the lesson? (What do you want students to know and understand about mathematics as a result of this lesson?)</p>
<p>In what ways does the task build on students' previous knowledge? What definitions, concepts, or ideas do students need to know to begin to work on this task? What prompts will you need to help students access their prior knowledge?</p>
<p>What are all the possible solution pathways for the task?</p> <p>Which of these pathways or strategies do you think students will use?</p> <p>What misconceptions might students have?</p> <p>What errors might students make?</p>
<p>What are the language demands of the task? How will you address these challenges if students are stuck during the task?</p>
<p>What are your expectations for students as they work on and complete this task? What tools or technology will they utilize to enhance student-to-student discourse?</p>

Source: Adapted from Smith, Bill, & Hughes, 2008.

**Figure 1.9: Task-analysis discussion tool.**

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## Team Progress

It is helpful to diagnose your collaborative teams' reality and action prior to launching the unit. You can use the before-the-unit status check tool for HLTA 2, identifying higher-level-cognitive-demand mathematical tasks, in table 1.2 as a diagnostic and feedback tool with your teacher teams. It matters less which stage your teams are at and more that team members are committed to working together to focus on understanding the learning standards and the best activities and strategies for increasing student understanding and achievement as teams seek stage IV—sustaining.

Of course, using balanced-cognitive-demand tasks becomes an important feature of the common assessment instruments for the end of the unit as well. Creating and using common assessment instruments with balanced-cognitive-demand tasks for each essential learning standard is the next high-leverage team action for your teacher teams' work.

**Table 1.2: Before-the-Unit-Begins Status Check Tool for HLTA 2—Identifying Higher-Level-Cognitive-Demand Mathematical Tasks**

<b>Directions:</b> Discuss your perception of your team's progress on the second high-leverage team action—identifying higher-level-cognitive-demand mathematical tasks. Defend your reasoning.			
<b>Stage I: Pre-Initiating</b>	<b>Stage II: Initiating</b>	<b>Stage III: Developing</b>	<b>Stage IV: Sustaining</b>
We do not discuss or share our use of the mathematical tasks in each unit of the curriculum.	We discuss and share some mathematical tasks we will use during the unit.	We explore and practice together mathematical tasks we will use during the unit.	We reach agreement on a collection of mathematical tasks every team member will use.
We do not share our understanding of the difference between lower- and higher-level-cognitive-demand mathematical tasks.	We do not base our instructional decisions and mathematical task choices on the cognitive demand of the task.	We are able to compare and contrast higher- and lower-level-cognitive-demand mathematical tasks for each learning standard of the unit.	We reach agreement on both the solution pathways for each mathematical task and the management of those tasks in the classroom.
We do not discuss the cognitive demand of the tasks we use in class.	We have reached agreement on what differentiates a higher- from a lower-level-cognitive-demand mathematical task.	We connect the mathematical tasks to the essential learning standards, daily lesson learning objectives, and corresponding activities for each unit.	We choose mathematical tasks that represent a balance of lower- and higher-level cognitive demand for the learning standards of the unit.
We do not use higher-level-cognitive-demand mathematical tasks.	We use higher-level-cognitive-demand mathematical tasks if they are included in the lesson.	We create higher-level-cognitive-demand mathematical tasks from lower-level-cognitive-demand mathematical tasks individually.	We create higher-level-cognitive-demand mathematical tasks from lower-level-cognitive-demand mathematical tasks as a team.

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## HLTA 3: Developing Common Assessment Instruments


*One of the most powerful, high-leverage strategies for improving student learning is the creation of frequent, high-quality, common formative assessments.*


—Richard DuFour, Rebecca DuFour, Robert Eaker, and Thomas Many

The mathematical tasks your teacher teams choose for their lessons partially answer the second critical question of a PLC—How will we know if they know it? The choices your teams make for the common assessment *instruments* they give students during and at the end of the unit fully answer this question.

As your teams make sense of the essential learning standards for the unit and better understand how to choose, adapt, and create higher-level-cognitive-demand mathematical tasks and learning activities, your teams will be ready to develop and use common assessment instruments to assess students' procedural fluency and understanding of the essential learning standards for the unit.

High-Leverage Team Action	1. What do we want all students to know and be able to do?	2. How will we know if they know it?	3. How will we respond if they don't know it?	4. How will we respond if they do know it?
<b>Before-the-Unit Action</b>				
HLTA 3. Developing common assessment instruments				

 = Fully addressed with high-leverage team action

 = Partially addressed with high-leverage team action

### The What

#### Real-Life Leadership Scenario

*This high-leverage team action is a top priority of our Mathematics at Work team in every school we support. It is a first order of team business, so to speak. We were working in a more urban Midwest school district with K-5 teachers. The third-grade team was having a difficult time creating high-quality assessments, understandably so, after years of depending on the district office to do this for them. There was some push back and reluctance to do the work. Sometimes I [Tim] yield on an expected action—if I think the team may not be quite ready to take an important step like this in their growth. During this time, I was also speaking and working at Solution Tree's PLC Institutes. I was sitting on a panel with my colleague and friend Rick DuFour, who is the vision and voice of the PLC at Work framework. Rick made the comment to a member in the audience: "If you take away the real work teachers are to do in their teams, then you take away their learning." At that moment, I knew he was right. That third-grade team, the principal, and I were just going to have to dig in, learn, and grow, no matter how painfully, together. And we did—and so did the students.*

*Results in the school that spring soared as the teachers took greater ownership in the student assessments, the results of those assessments, and the instruction necessary to help students be prepared for learning the essential standards being assessed. And it all started by learning how to write high-quality common assessments together. The principal decided this should not be a math activity only for her teacher teams; they should begin to do the hard work of writing common assessments for everything taught in the school. It was my role to teach her the protocols for designing and evaluating high-quality mathematics assessments that should guide this aspect of teacher teamwork.*

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Why is developing common assessment instruments an important *before-the-unit* high-leverage team action for you to monitor? The process of creating *common* assessment instruments for each unit (and not just relying on the district assessments) for each grade level or course supports teacher conversations about prerequisite concepts and skills, common student errors, and ways of assessing students' understanding of the essential learning standards (including both content and process standards for the unit). It allows teachers to design lessons backward to connect the outcomes (student demonstrations of knowledge on essential learning standards) for the unit to the learning activities, tasks, and resources students use during the unit—what is needed for student success on the end-of-unit assessments.

According to DuFour, DuFour, Eaker, and Many (2010):

One of the most powerful, high-leverage strategies for improving student learning available to schools is the creation of frequent, high-quality, common formative assessments by teachers who are working collaboratively to help a group of students acquire agreed-upon knowledge and skills. (p. 75)

In a PLC culture, this is a non-negotiable teacher team action.

However, there is an important distinction between formative assessment *processes* your teams use and the assessment *instruments* they use as part of that formative process. W. James Popham (2011) provides a powerful analogy to describe the difference between summative assessment instruments (such as end-of-unit tests) and formative assessment processes (such as what you and your students *do* with those test results). He describes the difference between a surfboard and surfing. The surfboard is a key component in the surfing process, but it is not the entire process. The entire process involves the surfer paddling out to an appropriate offshore location, selecting the right wave, choosing the most propitious moment to catch the chosen wave, standing upright on the surfboard, and staying upright while a curling wave rumbles toward shore.

Your teams' assessment instruments are some of the tools members use to collect data about student demonstrations of the essential learning standards. The assessment instruments subsequently will inform your teachers' and students' ongoing decisions about learning. Assessment instruments vary by grade level and can include such tools as teacher observations and interviews, exit slips, quizzes, unit tests, performance-item tasks, and in-class assignments.

However, to avoid inequity in the mathematics rigor for student learning, and to serve the formative learning process, these assessment instruments must be *in common* to each teacher on your grade-level or course-based team. When your collaborative teams create and adapt unit-by-unit common assessment



instruments together, they enhance the coherence, focus, and fidelity to student learning expectations across all collaborative team members. (Team members will become less dependent on an outside authority such as the textbook or the district office.) The development of common assessments is so critical to student learning that it is specifically listed as one of the actions teachers should collaborate on under the professionalism principle in *Principles to Actions* (NCTM, 2014).

You can help your teacher teams by monitoring the effective implementation of these common assessment instruments and to make sure they are used as intended, and not modified by individual teachers. You should collect them as they are designed, or redesigned, and review them for fidelity and quality. This is important as the assessments provide the hope for greater coherence, progression, and continuity for mathematics in the following year, and better student preparation.

Teachers minimize the wide variance in student task performance expectations (an inequity creator) from teacher to teacher by working collaboratively to design high-quality assessment instruments appropriate to the identified essential learning standards for the unit. Thus, the first questions you must ask each collaborative team are: “How do we know our end-of-unit assessments are of high quality? On what basis do we make these determinations?”

## The How

Collaborative teams should consider the following when creating high-quality assessment instruments.

- What level of cognitive demand will we expect for each essential learning standard on the exam?
- What evidence of content knowledge will we assess for each essential learning standard?
- What evidence of student engagement in Mathematical Practices and processes will we assess for each essential learning standard?
- What types of question formats will we use to evaluate specific evidence of learning (such as multiple choice, short answer, multiple representations, explanation and justification, or the use of technology)?

## *Evaluating the Quality of Teachers' Current Assessment Instruments*

One of the most important leadership actions you can take is to collect all of the unit-by-unit mathematics assessment instruments your teachers use. Are they of high quality, and how would you know? Figure 1.10 (page 34) is a quality-evaluation tool for during-the-unit or end-of-unit assessment instruments that your collaborative teams can use to evaluate the quality of the current unit assessment instruments, such as tests and quizzes, as well as to build new and revised assessment instruments for each unit of the course.

Assessment Indicators	Description of Level 1	Requirements of the Indicator Are Not Present	Limited Requirements of This Indicator Are Present	Substantially Meets the Requirements of the Indicator	Fully Achieves the Requirements of the Indicator	Description of Level 4
Identification and emphasis on essential learning standards (specific feedback to students)	Learning standards are unclear and absent from the assessment instrument. Too much attention is given to one target.	1	2	3	4	Learning standards are clear, included on the assessment, and connected to the assessment questions.
Visual presentation	Assessment instrument is sloppy, disorganized, difficult to read, and offers no room for work.	1	2	3	4	Assessment is neat, organized, easy to read, and well-spaced, with room for teacher feedback.
Balance of higher- and lower-level-cognitive-demand tasks	Emphasis is on procedural knowledge with minimal higher-level-cognitive-demand tasks for demonstration of understanding.	1	2	3	4	Test is rigor balanced with higher-level and lower-level-cognitive-demand tasks present.
Clarity of directions	Directions are missing and unclear. Directions are confusing for students.	1	2	3	4	Directions are appropriate and clear.
Variety of assessment task formats	Assessment contains only one type of questioning strategy, and no multiple choice or evidence of the Mathematical Practices. Calculator usage not clear.	1	2	3	4	Assessment includes a blend of assessment types and assesses Mathematical Practices modeling or use of tools. Calculator expectations are clear.
Tasks and vocabulary (attending to precision)	Wording is vague or misleading. Vocabulary and precision of language are a struggle for student understanding and access.	1	2	3	4	Vocabulary is direct, fair, accessible, and clearly understood by students, and they are expected to attend to precision in response.
Time allotment	Few students can complete the assessment in the time allowed.	1	2	3	4	Test can be successfully completed in the time allowed.
Appropriate scoring rubric (points)	Scoring rubric is not evident or is inappropriate for the assessment tasks presented.	1	2	3	4	Scoring rubric is clearly stated and appropriate for each task or problem.

Source: Adapted from Kanold, Kanold, & Larson, 2012, p. 94.

**Figure 1.10: Assessment instrument quality-evaluation tool.**

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A simple step would be to require each of your collaborative teams to rate and evaluate the quality of one of its most recent end-of-unit or chapter assessment instruments (tests). Using figure 1.10 and figure 1.11, the high-quality assessment diagnostic and discussion tool, ask members to evaluate the quality of the end-of-unit test as a team and report to you what they learned from the rating exercise.

How did it score? A 12? 16? 22? How close did the assessment instrument (the surfboard, so to speak) come to scoring a 27 or higher out of the 32 points possible in the rubric? You should expect that your teacher teams would write common assessment instruments that would score fours in all eight categories of the assessment evaluation rubric.

**Directions:** Examine your most recent end-of-unit assessment instrument, and evaluate its quality against the following eight criteria.

- 1. Are the essential learning standards written on the test?** What do your students think about learning mathematics? Do your students think learning mathematics is about doing a bunch of problems? Or, can they explain the essential learning standards and perform on any task that might reflect that standard?

Note: This is a necessary test feature if students are to respond to the end-of-unit assessment feedback when you pass it back. (See HLTA 9, page 103.)

- 2. Does the visual presentation provide space for student work?** Do your students have plenty of space to write out solution pathways, show their work, and explain their thinking for each task on the assessment instrument?

Note: This criterion often is one of the reasons not to use the written tests that come with your textbook series. You can use questions from the test bank aligned to your instruction, but space problems as needed.

- 3. Is there a balance of higher- and lower-level-cognitive-demand questions on the test?** What percentage of assessment instrument tasks are lower-level cognitive demand? What percent are higher-level cognitive demand? Is there a balance? Unless this has been a major focus of your work, your current end-of-unit tests will not score very high in this criterion.

Note: Underline the verbs on your test, and analyze what the verbs are asking the student to do. This will help you to better understand the level of cognitive demand. A good rule of thumb is that the rigor-balance ratio should be about 30/70 (higher- to lower-level cognitive demand).

- 4. Is there clarity with all directions? What does clarity mean to each team member?** Are any of the directions for the tasks confusing to the student? Why?

Note: The verbs used in your directions for each set of tasks are very important to notice when discussing clarity.

**Figure 1.11: High-quality assessment diagnostic and discussion tool.**

continued →

**5. Is there variety in the assessment formats?** Does your test use a blend of assessment formats or types? Did you include questions that allow for technology as a tool, such as graphing calculators? Did you balance the use of different question formats? If you use multiple choice, do you include items with multiple possible answers similar to those on the PARCC, SBAC, or other state assessments?

Note: Your end-of-unit assessments should not be of either extreme—all multiple-choice or all open-ended questions.

**6. Is the language precise and accessible?** Is the vocabulary for each task in your end-of-unit assessment clear, accessible, and direct for students? Does it reflect the precision of language you use during the unit and that students understand?

Note: Be sure the assessment instrument uses the proper language supports for all students.

**7. Is the allotted time appropriate?** Can your students complete this assessment in the time allowed? What will your procedure be if they cannot complete the assessment within the allotted time?

Note: Each teacher on the team should complete a full solution key for the assessment. For upper-level students, it works well to use a time ratio of 3:1 (or 4:1) for student-to-teacher completion time to estimate how long it will take students to complete an assessment. (If it takes you ten minutes, you should allow thirty to forty minutes for the students to complete the assessment.) All teachers should use the agreed-on time allotment.

**8. Is the scoring rubric clear and appropriate?** Are the scoring rubrics for every task clearly stated on the test? Do your total points for the test make sense based on the tasks' complexity of reasoning? Are the tasks' points appropriate, and do all teachers agree on them?

Note: See HLTA 4, page 41, for more details.

Using your score from this assessment tool, which specific aspects of your current unit assessment instruments do you need to improve?

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**Figure 1.11: High-quality assessment diagnostic and discussion tool (continued).**

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The value of any collaborative team–driven assessment depends on the extent to which the assessment instrument reflects the essential learning standards, can be used as part of a formative learning process in the aftermath of the assessment (see HLTA 9 in chapter 3 of this handbook), provides valid evidence of student learning, and results in a positive impact on student motivation and learning.

### ***Designing a High-Quality Assessment Instrument***

Providing time and expecting every teacher team to design common assessment instruments before the unit begins is a required aspect of your leadership. You will need to monitor this essential teacher team work as it provides a context for discussing prerequisite knowledge that teachers may need to address during instruction while simultaneously making sense of the learning standards and establishing a common expectation for student learning. It also provides a context for discussing where students might make common errors or hold common misconceptions. You will need to make sure teams have the necessary time, and then make this work a priority action (first order of business, so to speak) of your teams.

Your teams can use the questions in figure 1.12 (page 38) as a way to unpack an essential learning standard and prepare mathematical tasks and questions for teams' next common end-of-unit assessment instrument that they give to students.

Once teams identify and explore prerequisites and common errors, the teams are better prepared to find or develop the common assessment instrument tasks or questions. If this is a new activity for your collaborative teams, it might make sense to start with an existing assessment instrument and then ask teams to adapt it so that it addresses the essential learning standards comprehensively (listing them on the test itself for grades 3–12 and on the teacher's edition of the test for grades K–2) and provides an appropriate balance of higher- and lower-level-cognitive-demand tasks.

Perhaps the greatest challenge your teacher teams may face is balancing higher- and lower-level-cognitive-demand tasks on each unit exam. Cognitive-demand balance is the third criterion listed in the high-quality evaluation tool from figure 1.11 (page 35–36). When you review the end-of-unit assessment instruments your teams use (remember you are going to collect them from each grade- or course-level team for every unit), do the teams score well in terms of expected rigor balance? Did an appropriate blend of higher-level- and lower-level-cognitive-demand mathematical tasks and questions exist on the assessment?

**Directions:** Choose an essential learning standard you are planning to assess in your next end-of-unit assessment, and answer the following questions. Be sure to look very carefully at the verbs that describe the essential standard. They will provide hints about the question or task types you will need for the test.

Essential learning standard: \_\_\_\_\_

1. What prerequisite skills are necessary for this essential learning standard? How will you assess students' knowledge of these prerequisites?
2. What are common errors related to this essential learning standard? How will your instruction identify and resolve these errors before students take the common unit assessment?
3. How does your conversation around planning common assessment instruments influence your plans for instruction during the unit?
4. What mathematical tasks will you use during instruction for this essential standard, and what tasks will you reserve for the assessment of this standard?

**Figure 1.12: Tool for planning and preparing for common assessment instrument task development.**

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You can help your collaborative teams by asking them to use the questions from figure 1.13, checking for cognitive-demand balance on the common unit assessment instrument, as a general team discussion guide for creating an improved balance between higher- and lower-level-cognitive-demand tasks and student opportunities to identify common errors related to the essential learning standards.

**Directions:** With your collaborative team, answer the following questions to check the cognitive-demand balance of your common assessment instruments.

1. What does the current assessment instrument do well in terms of the nature of the cognitive demand for each mathematical task on the test?
2. How are prerequisite skills and common misconceptions regarding the essential learning standards addressed in this assessment instrument?
3. Which items on the assessment should remain as lower-level-cognitive-demand tasks?
4. Which items are more easily adapted into higher-level-cognitive-demand tasks? And how might you adapt them toward a higher level of cognitive demand?

**Figure 1.13: Checking for cognitive-demand balance on the common unit assessment instrument.**

Visit [go.solution-tree.com/mathematicsatwork](https://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this figure.

Your grade-level or course-based teams do not need to design unit assessments from scratch. You can use assessment instruments provided with your curriculum materials or the district and then discuss or adjust them to ensure they identify the essential learning standards, uncover common misconceptions, are appropriately balanced with respect to cognitive demand, provide the necessary time and space, and use appropriate, clear language and vocabulary.

Your collaborative teams could also create their own agreed-on criteria for assessment instrument quality using figure 1.11 (page 35–36) as a starting point based on your local vision for higher-level quality assessment. Use the tools in this chapter as a starting point for discussion, or adapt the tools if needed, to fit your vision for using high-quality assessment instruments in your mathematics program.

Just remember, your most important role is to collect copies of the tests teachers use, review them with key mathematics personnel in your school or district, give feedback about their quality, and make sure all teachers on the team are using them—that they are, in fact, *common*. You can visit [go.solution-tree.com/mathematicsatwork](https://go.solution-tree.com/mathematicsatwork) to download sample exams appropriate to your grade level or course-based area of leadership.

## Team Progress

It is helpful for your collaborative teams to diagnose their reality prior to launching the unit. Ask each team to assess its progress using the before-the-unit status check tool for HLTA 3, developing common assessment instruments, in table 1.3 (page 40) to determine how the collaborative team is currently functioning. Discuss your perception of your teams' progress on developing common assessment instruments. It matters less which stage your teams are at and more that team members are committed to

working together to focus on understanding the learning standards and the best activities and strategies for increasing student understanding and achievement as your teams seek stage IV—sustaining.

**Table 1.3: Before-the-Unit-Begins Status Check Tool for HLTA 3—Developing Common Assessment Instruments**

<b>Directions:</b> Discuss your perception of your team's progress on the third high-leverage team action—developing common assessment instruments. Defend your reasoning.			
<b>Stage I: Pre-Initiating</b>	<b>Stage II: Initiating</b>	<b>Stage III: Developing</b>	<b>Stage IV: Sustaining</b>
We do not develop or use common assessment instruments.	Some members of our team develop common assessment instruments.	We develop common assessment instruments as a team, but not before the unit begins.	We design and write common assessments as a team before the unit begins.
We do not know if the end-of-unit assessments given by each member of the team are balanced for cognitive demand, provide sufficient time, and use clear language and vocabulary.	We develop end-of-unit common assessments connected to the learning standards, but they are not checked for balance of cognitive demand or clarity.	We develop common end-of-unit assessment instruments connected to the learning standards. They are either balanced for cognitive demand or clear but not both.	We develop common end-of-unit assessments that are clear, balanced, and connected to all aspects of the essential learning standards for the unit.
We do not know if our assessments are aligned to our instructional practices and reflect the essential learning standards of the unit.	We develop common assessments as a team, but not all members use them to influence their instructional plans for the unit.	Our planning for common assessments influences our instructional plans for the unit.	Our common assessments are deeply aligned with our instructional discussions and practices.

Visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this table.

Once teams have prepared their common unit assessments, their efforts should turn to creating scoring rubrics for the test and developing expected proficiency expectations for students. Developing scoring rubrics and proficiency expectations for the common assessment instruments is the fourth high-leverage team action in the before-the-unit planning process. The process of developing scoring rubrics requires teams to reflect and stay focused on the essential learning standards for the unit. It also allows you to know whether or not there is a fidelity to the assessment of student work, no matter who the teacher for the grade level or course might be.




## HLTA 4: Developing Scoring Rubrics and Proficiency Expectations for the Common Assessment Instruments



*Do you trust me enough to allow me to grade your end-of-unit assessments?*

—Timothy D. Kanold

How well do you monitor to determine whether those who teach the same course or grade level will score all assessment instruments with a *fidelity of accuracy*? Creating a team culture of collaborative assessment scoring is an important activity for your grade-level or course-based collaborative teams—and you must lead the creation of a culture that values this activity.

Just as the mathematical tasks and common assessment instruments (tests and quizzes) help your collaborative teams to answer the second critical question of a PLC—How will we know if they know it?—so do the choices your teams make for scoring the mathematical tasks on the common unit assessments. The purpose of this team action will be discussed further in chapter 3, HLTA 9 and 10 (see page 101).

High-Leverage Team Action	1. What do we want all students to know and be able to do?	2. How will we know if they know it?	3. How will we respond if they don't know it?	4. How will we respond if they do know it?
Before-the-Unit Action				
HLTA 4. Developing scoring rubrics and proficiency expectations for the common assessment instruments				

  = Partially addressed with high-leverage team action

### The What

#### Real-Life Leadership Scenario

*In a recent school year, as the first grading period approached, a high school principal contacted me [Tim] and indicated she had received a number of complaints from concerned parents related to student grades in one section of advanced algebra because the grades were significantly lower than in other sections. There were three advanced algebra teachers in the building; I was puzzled because I knew all three to be experienced, effective teachers. In addition, I knew the team had agreed upon the essential learning standards (they were common), the curriculum included higher-level-cognitive-demand tasks, and that all three teachers used common formative assessments they had collaboratively developed.*

*In meeting with the advanced algebra team and discussing the results of their assessments, I asked to see the students' chapter tests from each of the teachers. What immediately became obvious was that one member of the team, the one with the lowest grades, was not grading her exams the same as the other two teachers.*

*The team thought they were implementing HTLA 4, but in reality they had only collaboratively decided how many points to award each problem—they had not reached consensus on how to award those points. Two of the teachers, for example, were awarding students full credit for any student solution pathway that was mathematically justified, while the third teacher was requiring students to solve problems in a specific manner and awarding points based on students' showing their work only for specific rote steps. This ultimately meant students in her class were not earning the same amount of credit as students in the other two classes for what were essentially the same solutions.*

*The team quickly realized that they had more work to do to ensure consistency in their grading practices and to help ensure that students' grades mean the same thing from class to class. The teacher who was not grading her tests the same way as the other two teachers at first refused to grade her tests like her two colleagues did, complaining that the "other teachers' standards were too low." I visited with the principal, who had to then work directly with the team for a period of time to ensure they all used common scoring rubrics. Eventually, as all members of the team understood the importance of common scoring rubrics, they began to develop and use them, grades between advanced algebra sections leveled out, and parent complaints about grading faded.*

---

High-leverage team action 4 will improve the way your teachers provide instruction pathways for students during the unit. It will also improve the accuracy of their feedback and their grading practices at the end of the unit. Additionally, an extra benefit for you is the greater equity in the meaning and interpretation of student scores, regardless of the teacher for that grade level or course.

By expecting your teams to reach full agreement on the rubric score for each item on the end-of-unit test, you increase the reliability that the feedback for proficiency on the essential learning standards for the unit is accurate, and you increase the likelihood that all students understand the expectations of a solution pathway required to receive full credit on the task.

Most important, by monitoring this team action, you serve as an *inequity eraser* in your school or district, increasing the likelihood that teacher feedback on student performance will be consistent and accurate across all teachers in your school and that the same grades will mean the same level of learning has occurred from classroom to classroom in your building and district. This simple teacher team act has a very powerful student benefit for vertical learning from year to year and after eighth grade from course to course.

Determining how to score the mathematics tasks on an end-of-unit common assessment instrument involves far more than linking point values to test questions and tasks. As your teachers work together on scoring rubrics for the mathematical tasks, their instruction during the unit will benefit from:

- Discussing the value of each task relative to the other tasks on the test
- Deciding how they will determine if students have provided a complete solution for full credit relative to the essential learning standard each assessment task (problem) represents
- Deciding what they will do when students' answers are incomplete or incorrect—how will their response be scored?

These decisions are typically easier to make and more straightforward with lower-level-cognitive-demand tasks (consider your teachers' past mathematics unit assessment instruments) but not as clear for the higher-level-cognitive-demand tasks necessary to measure student understanding, reasoning, *and* procedural fluency.

## The How

To help your teachers learn how to assign a score value to a mathematical task on a common assessment, ask them to examine a potential set of test questions (mathematical tasks), and engage in a collaborative discussion about the scoring of the task example.

If your collaborative teams do not have ongoing conversations about scoring, inequities will persist across the teams, and a grade (such as an A or B or a 1, 2, 3, or 4 proficiency) in one class will not be consistent with the grade in another class (another potential inequity). The examples that follow, around *one* test question only, emphasize that all teachers on the team need to discuss and practice *every* task (question) on the exam before giving the assessment instrument to students.

Your teams can use the collaborative team task-scoring discussion prompts in figure 1.14 (page 44) for any type of quiz or test tasks.

Ask your teams to practice using the prompts from figure 1.14 on the appropriate mathematical task in figure 1.15 (page 45). Most likely their answers will vary widely from one to three points, to four to six points, and to eight to ten points for full credit.

As a school leader, your goal is not so much to be concerned with the exact number of points teachers assign to the mathematical task but rather that each team member is using the same scoring values. As students progress through the grade levels and experience higher-level-cognitive-demand mathematical tasks, collaborative team scoring becomes an even more pressing concern for your teacher teams.

**Directions:** With your collaborative team, discuss scoring for the task appropriate to your grade level from figure 1.15. Respond to each of the following questions.

1. What would you require students to demonstrate in order to receive full credit for the task? Think about solution pathways for the task.

2. How would you assign a score for proficiency to each part of a student's response?

3. How would you calibrate your individual responses in order to reach a scoring consensus agreement on the task with your collaborative team?

**Figure 1.14: Collaborative team task-scoring discussion prompts.**

Visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this figure.

### Grade 4 Task

Drag each expression to the correct column to show whether the product is less than or greater than 1.

Less Than 1			Greater Than 1		
$3 \times \frac{1}{2}$	$5 \times \frac{1}{4}$	$1 \times \frac{1}{5}$	$4 \times \frac{3}{5}$	$2 \times \frac{2}{5}$	

### Grade 7 Algebra Task

**Standard:** I can understand the meaning of equivalent expressions.

Look at each expression.

Is it equivalent to  $\frac{x + 3y}{2}$ ?

Select Yes or No for expressions A–D.

**A.**  $\frac{4x + 3y}{8}$  ☐ Yes ☐ No

**B.**  $\frac{5}{4} \left( \frac{2x + 6}{5} \right)$  ☐ Yes ☐ No

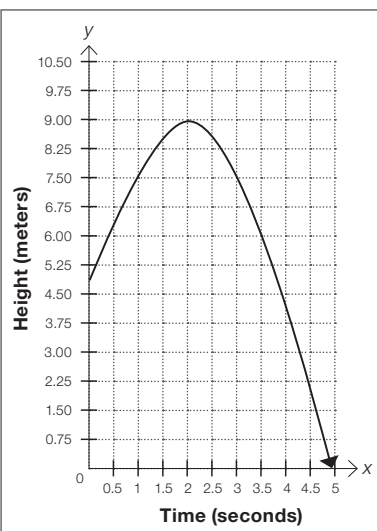
**C.**  $\frac{1}{2} (x + 3y)$  ☐ Yes ☐ No

**D.**  $\frac{2}{3} \left( \frac{5x}{6} + \frac{9y}{4} - \frac{x}{12} \right)$  ☐ Yes ☐ No

Explain why each choice (A, B, C, and D) is equivalent or why it is not equivalent.

### Grade II Algebra Task

A ball is thrown in the air. The height of the ball in terms of time is modeled by the graph shown. A second ball is thrown from a lower initial height and reaches a higher maximum height.



- Select an equation that represents the height of the second ball in terms of time. Explain your reasoning.

$y = -x^2 + 2x + 3$	$y = x^2 - 3x + 4$	$y = -x^2 + 4x + 6$
$y = -x^2 + 5x + 3$	$y = x^2 - 4x + 2$	$y = -x^2 + 5x + 5$

- What is the initial height of the second ball in terms of time?
- What is the maximum height of the second ball?

Source: Smarter Balanced Assessment Consortium, 2013a; 2013b; 2013c. Used with permission.

**Figure 1.15: Mathematical tasks for collaborative team task-scoring practice.**

### ***Creating a Team Scoring Rubric for Each Assessment***

There is not one right answer when considering point values for the mathematics assessments given to students in your school. What is important is that you make sure your teams use the same scoring scale and base the scoring rubric on a decided standard (such as the complexity of reasoning the assessment task requires or a proficiency scale based on lower- or higher-level cognitive demand) and make sure that each collaborative grade-level or course-based team member honors the scoring scale. Part of your leadership work is to monitor this critical teacher team behavior. This equity pursuit will allow teams to hold the scoring of student work to a higher standard of accuracy, which we discuss in more detail with HLTA 9 in chapter 3 (page 103).

Your collaborative teams should use the prompts from figure 1.16 and answer the questions in order to calibrate their thinking regarding scoring a unit assessment. You can support this HLTA by asking your teams to occasionally provide their responses using the tool in figure 1.16 as you review their ongoing assessment work.

**Directions:** Within your collaborative team, answer each of the following questions in relation to each task on the assessment.

1. Which essential learning standard does each task address, and how do you know?
2. What do you expect students to demonstrate in order to successfully respond to and receive full credit for each task on the assessment?
3. How will you assign partial credit?
4. To which Mathematical Practices does each task develop? Describe why or why not.
5. What is the scoring value or point value assigned to each task, and how many total points should be used for this end-of-unit assessment?
6. Are there any questions on the test you would want to ask differently? If so, how would that impact the point value you would assign to the test question or task?
7. How many points correct would a student need for each essential learning standard in order to be considered proficient for that standard (the proficiency target)?

**Figure 1.16: Assessment instrument alignment and scoring rubric tool.**

Visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this figure.

## Setting Proficiency Targets

Notice the last question in figure 1.16: How many points correct would a student need for each essential learning standard in order to be considered proficient for that standard (the proficiency target)?

Your teams should decide what level of student performance will be considered proficient in each of the essential learning standards for the end-of-unit assessment. Your teams should know the learning score target they will expect each student to obtain for each learning standard to be considered proficient for that essential learning standard. Your teams' responses to students who do or do not achieve the learning proficiency target is the action described in HLTA 9 and discussed further in chapter 3 (page 101).

There is a type of standards-based grading practice gaining popularity in grades K–8 across the United States. It involves measuring students' proficiency on well-defined course learning standards (Marzano, 2010). Although many districts adopt standards-based grading *in addition* to traditional grades, standards-based grading can replace traditional point-based grades. If this is the case at your school, and you want more information on standards-based grading, you can go to [www.marzanoresearch.com](http://www.marzanoresearch.com) to review Robert Marzano's (2010) *Formative Assessment & Standards-Based Grading* or *A School Leader's Guide to Standards-Based Grading* (Heflebower, Hoegh, & Warrick, 2014) and learn more about the use of proficiency scales to score student work and measure student progress.

## Team Progress

It is helpful to diagnose your collaborative teams' reality and action prior to launching the unit. Ask each team to assess its current reality using the before-the-unit status check tool for HLTA 4, developing scoring rubrics and proficiency expectations for the common assessment instruments, in table 1.4 (page 48). It matters less which stage your teams are at and more that team members are committed to working together and understanding the various student pathways for demonstrating solutions to the mathematical tasks on common assessments as your teams seek stage IV—sustaining.

These first four high-leverage team actions give your teams:

- A direct focus on your unit-by-unit understanding of and decisions regarding the essential learning standards
- Insight into the mathematical tasks and activities that support your work during the unit
- Understanding of common assessments to determine whether or not students have attained the content and process knowledge of the essential learning standards
- Guidelines for how to score student work and set proficiency expectations for each essential learning standard of the unit

There is one major high-leverage, equity-based team action left to complete before your teams launch into the unit and instruction: planning and using common homework assignments.

**Table 1.4: Before-the-Unit-Begins Status Check Tool for HTLA 4—Developing Scoring Rubrics and Proficiency Expectations for the Common Assessment Instruments**

<b>Directions:</b> Discuss your perception of your team's progress on the fourth high-leverage team action—developing scoring rubrics and proficiency expectations for the common assessment instruments. Defend your reasoning.			
<b>Stage I: Pre-Initiating</b>	<b>Stage II: Initiating</b>	<b>Stage III: Developing</b>	<b>Stage IV: Sustaining</b>
We do not use common scoring rubrics on our assessments.	We discuss our scoring and grading practices collaboratively.	We create scoring rubrics for our common unit assessments collaboratively.	We create dependable scoring rubrics for all tasks on the common unit assessments as a collaborative team.
Each teacher establishes his or her own scoring system for their independent assessments.	We have not yet reached agreement on how to score the tasks on our common assessments.	We discuss and reach agreement on a student's complete response to receive full credit on each task for our common assessments.	We design assessment rubrics to align with students' reasoning about the mathematics for each essential learning standard of the unit.
We do not know the scoring and grading practices other members of our team use.	We use scoring rubrics independently, and do not discuss our use of scoring rubrics with other members of the team.	We use the common end-of-unit assessment scoring rubrics for measuring student proficiency on each learning standard but don't discuss them as a team.	We use the common end-of-unit assessment scoring rubrics for measuring student proficiency on each learning standard and discuss them as a team.
We do not set student proficiency targets for each essential learning standard of the unit.	We set student proficiency targets independently, but do not know the proficiency targets other members of our team use for each essential learning standard of the unit.	We collaboratively set student proficiency target performances on the end-of-unit assessment for some, but not all, of the essential learning standards of the unit.	We collaboratively set student proficiency target performances on the end-of-unit assessment for each essential learning standard of the unit.

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## HLTA 5: Planning and Using Common Homework Assignments

*Assign work that is worthy of their best effort (problem solving and reasoning).*





—Linda Darling-Hammond

*By using homework for practice in self-assessment and complex thinking skills, we can put students in charge of the learning process.*


—Cathy Vatterott

The mathematical tasks and problems your teachers assign *as homework* should help students to accurately answer the question, “How will I know if I understand the essential learning standards of the unit each and every day?” Thus, you need to ensure your teacher teams reach agreement on the purpose, coherence, rigor, and length of time for homework. In addition, teams need to agree on how to use common homework assignments and communicate this to students, parents, and support staff. Once again, your teams’ work to develop common homework assignments for the unit, before it begins, can help eliminate another potential inequity creator that you can monitor for and help to erase.

You should plan on collecting evidence of the homework assignments given to students for every unit. This is another way your teams reach agreement on the second critical question of a PLC: How will we know if they know it?

High-Leverage Team Action	1. What do we want all students to know and be able to do?	2. How will we know if they know it?	3. How will we respond if they don't know it?	4. How will we respond if they do know it?
<b>Before-the-Unit Action</b>				
HLTA 5. Planning and using common homework assignments				

 = Fully addressed with high-leverage team action

 = Partially addressed with high-leverage team action

### The What

#### Real-Life Leadership Scenario

*One year at the annual NCTM conference, I [Tim] presented a session on the topic of mathematics homework. At the end of the session, there was a long line of teachers with questions, as this can be a very difficult topic to address. Two fourth-grade teachers from Sweden came up to me and said, “You butchered the homework!” I was not sure if this was good or bad. I took a deep breath and asked what they meant. They explained, “You took the knife and stabbed the beast!” At that moment, I understood the need to tackle the topic—to eliminate the secrecy around how teachers decide to assign independent practice to students and to make the creation and assignment of mathematics homework a collaborative team effort for the grade level*

*or course. The young men from Sweden understood. I left wondering how many school principals actually monitor and know the exact mathematics homework (quality and quantity) teachers assign to students in their building each and every day. Why are the decisions about mathematics homework (independent and measured student practice) in most schools such a private teacher act?*

---

Planning and using common homework assignments is an important before-the-unit high-leverage team activity because mathematics homework is often an instructional area that lacks clarity, purpose, and certainty for students, parents, intervention support personnel, and most important, for you as a school leader. You should help your teams by asking them, “Why do we give students mathematics homework? What is the purpose of mathematics homework? Why won’t students do their mathematics homework? Why do you spend so much time going over mathematics homework in class? Why is mathematics homework assigned for a grade?”

The very idea of homework, and what to do with it, is often a conundrum for you, your teachers, and your students. Is homework really an essential element to the process of student learning? The short answer is yes, but the best protocols to follow for homework are not quite as clear.

However, four things are clear.

1. The assignment of independent practice or homework cannot be a superficial exercise for your teacher teams or your students.
2. Anyone who is an expert at anything devotes significant time to practice (Gladwell, 2008).
3. If teachers deny students an opportunity for independent practice, they deny them the very thing they need to develop real competence (Anderson, Reder, & Simon, 1995).
4. Homework assignments need to be spaced and in common.

The homework teachers assign to students as well as the way they use homework as an in-class activity, in other words, as a formative task to guide instruction, needs to be a carefully thought-out and planned-for *team* discussion, agreement, and activity *before* the unit begins (Gladwell, 2008).

Although research on homework does not support a clear path for all grades and all subjects (Cooper, 2008a, 2008b), the issue of homework becomes more complicated as attention turns to implementing the Common Core State Standards and other more rigorous state standards and understanding them (and thus higher-level-cognitive-demand practice problems).

Research does indicate that homework can be helpful in improving student achievement if implemented appropriately (Cooper, 2008b). A key finding from the research is that homework is most effective when teachers provide feedback to students’ homework on a daily basis and give students written descriptive feedback that goes beyond simply marking student work as correct or incorrect (An, 2004; Davies, 2007; Marzano, 2006).

Practice is important but not without first developing student understanding. Practice without understanding may be detrimental to students’ development of fluency, and in many cases, avoiding this danger

means that instruction should place greater emphasis on guided practice—practice that is supported by monitoring and feedback—prior to independent practice (Larson, 2011). Marzano (2007) finds that to have a positive effect, homework should also have a clear *purpose* that teachers communicate to students: to deepen students’ conceptual understanding, enhance procedural fluencies, or to allow students an opportunity for independent formative practice around higher-level-cognitive-demand tasks. Teachers should intentionally consider and choose each homework problem or mathematical task carefully based on the essential learning standards of the lesson and unit.

Research also supports the idea of *spaced* (sometimes called *distributed* or *spiral*) versus *massed* homework practice during the unit of study (Hattie, 2012; Pashler, Rohrer, Cepeda, & Carpenter, 2007) as having a significant impact on student learning. That is, teachers should provide homework assignment (practice) tasks that are spaced throughout the unit, allowing students to cycle back and perform distributed practice on prior learning standards, including those learned earlier in the unit, in previous units, or possibly in the previous grade level.

Teams should design practice for student learning *outside of class* (homework) from the same core set of problems the team agreed on, thereby ensuring that each student, no matter what teacher they have for the course, would work to meet the same expectations.

## The How

Collaborative team discussions regarding the role of homework and the selection of homework problems can be a powerful professional growth experience and should be an embedded part of your teacher teams’ work every unit.

In general, you should expect your team leaders to provide you, your students, and parents with complete homework assignment sets before each unit begins, and you should monitor to ensure the mathematics homework in your school or district meets the standards described in this section of the handbook.

## Understanding the Purpose of Homework

You will need to help your teachers to understand the purpose of daily mathematics homework. You can use the collaborative homework assignment protocol discussion tool in figure 1.17 (page 52) to help your teams develop a better understanding of the purpose, content, and expected protocols for the unit’s homework assignments. These prompts can also be used for team discussion with vertical course-based teams as you examine mathematics homework protocols and progressions across all grade levels or courses in your building.

**Directions:** Use the following prompts to guide discussion of the unit's homework assignments.

**Purpose of homework:**

1. Why do we assign homework for each unit's lessons? What is the purpose of homework?

**Nature of homework:**

2. What is the proper number of mathematical tasks for daily homework assigned during the unit? In other words, how much time should students spend on homework?
3. What is the proper rigor (cognitive-demand expectations) of the mathematical tasks for homework assigned during the unit?
4. What is the proper distribution of tasks for homework to ensure spaced practice (cyclical review) for our students?
5. How do our daily homework assignments align to the learning standard expectations for the unit?
6. How will we reach consensus on unit homework assignments in order to ensure coherence to the student learning and practice expectations?

**Use of homework:**

7. How should we grade or score homework assignments?
8. What will we do if students do not complete their homework assignments?
9. How will we go over the homework in class?
10. How will we communicate the common unit homework assignments to students, parents, and support staff?

**Figure 1.17: Collaborative homework assignment protocol discussion tool.**

Visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this figure.

It is the expectation that your collaborative teams will reach full agreement on their responses in figure 1.17 before the unit begins to select appropriate independent practice task (homework problem) sets for students. You should collect and monitor these homework sets.

In response to figure 1.17, question one, Why do we assign homework for each unit's lessons? What is the purpose of homework?, it is important to note that the primary purpose of homework is *not summative*. Homework should not be assigned to students in order to assign a grade. In fact, homework should generally not count for more than 5 to 10 percent of the total student grade. Because homework is a *formative* activity—an opportunity to obtain feedback and improve learning—it should not constitute so much of a student's grade that it is not reflective of actual class performance at the end of a learning cycle.

The primary purpose of mathematics homework is *independent student practice*. More importantly, *successful* independent practice. That is, students must understand and use homework as an opportunity for a self-guided formative feedback learning process (Hattie, 2012). Independent practice can be with other students, it can be with other adults, it can be with help from YouTube or other social media resources. However, while outside of class, away from their teacher and guided in-class practice, students must practice mathematics problems and connect those problems to the essential learning standards.

Students need to come to understand that they complete homework, *not* because they will receive a grade, *not* because they hope the teacher will go over the problems in class the next day (which makes homework no longer an independent practice exercise), *not* because they are being punished, but only because they understand the importance of formative assessment and successful practice as a critical part of their long-term learning process. In class, students do need teacher modeling and lots of peer-to-peer guided practice (see HLTA 7 in chapter 2 of this handbook, page 75), and then outside of class, and in a timely fashion, students need to perform accurate independent practice with feedback (self-feedback or with peers) and then take action—well before they are back in class the next day.

Your role is to provide your collaborative teams with the time needed to determine how much homework to provide for additional student independent practice. Your teams must decide how to communicate the homework assignments to students and parents and the role homework plays as part of the classroom protocols described in figure 1.18 (page 54).

Again, this all should occur *before* the new unit of study begins. How will you know? Perhaps the homework paradigm shift for you and your teachers is to stop calling it *homework*. Certainly *independent practice* can be done at the coffee shop, after school in a classroom, on the bus, sitting in a hallway, in the car on the way to practice or a game, with friends at the library, or with parents; it does not have to be done at home.

### ***Using Effective Homework Protocols***

From a rigor, coherence, and equity point of view, the homework your teacher teams assign for a unit of study needs to be the same for all students in each mathematics course in your building. Teachers should give team-developed homework assignments to students, parents, and support staff in advance of teaching the unit with the understanding that teams can and will modify the assignments during the unit as necessary to address specific student learning needs. To check the temperature on how your teams are currently responding to the homework dilemma, you can use the homework quality diagnostic tool in figure 1.18 to measure team progress.

High-Quality Homework Indicators	Description of Level 1	Requirements of the Indicator Are Not Present	Limited Requirements of This Indicator Are Present	Substantially Meets the Requirements of the Indicator	Fully Achieves the Requirements of the Indicator	Description of Level 4
The primary purpose of homework is independent practice.	Homework is primarily assigned to give a student a grade. Homework counts more than 10 percent of a student's total grade.	1	2	3	4	Homework is understood as primarily for independent practice and a formative assessment learning loop for students. Homework counts no more than 10 percent of a student's grade.
Homework assignments are the same for every teacher on the course team.	Each teacher on the team creates his or her own homework assignments and does not share with others.	1	2	3	4	Common homework assignments are developed collaboratively by the team and are the same for all students in the grade level or course.
All homework assignments for the unit are given to the students before the unit begins.	Students find out homework assignments each day or each week as the unit progresses.	1	2	3	4	Students are provided all unit homework assignments—electronically or with a handout—as the unit begins.
Homework assignments for the unit are appropriately balanced for cognitive demand.	Homework practice problems are not balanced for rigor. Emphasis is on lower-cognitive-demand tasks.	1	2	3	4	Homework practice is appropriately balanced with higher- and lower-cognitive-demand tasks.
All practice problem answers are given to the students in advance of the homework assignments.	Students must wait until the next day to receive answers or solutions to homework practice problems.	1	2	3	4	Students are able to check their solutions during independent practice and are expected to rework the problems if not correct the first time.
Homework assignments for each unit exhibit spaced and massed practice.	The homework assignments represent superficial thought as to the problems chosen and consist of massed practice.	1	2	3	4	The homework assignments represent carefully chosen problems or tasks. Spaced practice from several lessons of the unit or previous units is included in addition to massed practice.
Daily homework is aligned to the essential learning standards of the unit.	Students are not able to make connections between the daily homework practice problems and the learning standards of the unit.	1	2	3	4	Students connect the homework practice as essential to helping them demonstrate knowledge of the essential learning standards of the unit.
Limited time is spent going over homework in class.	Students and the teacher spend fifteen to twenty-five minutes (or more) in class going over the homework answers and solutions. The teacher does most of the work as the students watch.	1	2	3	4	At most, five to seven minutes of class time are used discussing the homework. It is primarily a peer-to-peer class activity facilitated by the teacher.

**Figure 1.18: Homework quality diagnostic tool.**Visit [go.solution-tree.com/mathematicsatwork](http://go.solution-tree.com/mathematicsatwork) to download a reproducible version of this figure.

Ask your teams to use the diagnostic tool from figure 1.18 to give a score to the quality of their homework assignments for a given unit. The maximum score is 32. Note that teams should list the essential learning standards for the unit on the homework assignment sheet. Note too that the problems assigned for each lesson should illustrate spaced practice and not massed practice during the unit. You should monitor for evidence of these criteria.

Also, determine whether or not students (if age appropriate) or their parents have access to the mathematics homework assignment set online for each grade level or course as a Google Doc or some other web source. Finally, be sure to limit the amount of time (most days no more than five minutes of class time) spent going over the homework in class.

To summarize, you can guide collaborative team homework protocol development by asking your teacher teams to consider the following benchmarks.

- **Homework purpose:** The primary purpose of homework should be to allow the student the opportunity for *independent practice* on learning standards mastered in class during guided practice and small-group discourse. Homework can also provide a chance for the student to practice mathematical tasks that relate to previous learning standards or tasks that reflect prerequisite learning standards for the next unit. Homework that provides review of previous work and helps to prepare students for future work leads to improved student achievement (Cooper, 2008a).
- **Homework length:** How much time should daily homework take students to complete? How many problems should it entail? Homework should not be lengthy (Cooper, 2008b), so teachers should take care about what they assign. Take into account the cognitive demand of the tasks or problems you assign. Homework tasks as a general rule should not take more than thirty to thirty-five minutes (per course) of time outside of class.
- **Homework task selection:** The homework your school curriculum or textbook includes is not necessarily appropriate for students without some adjustments with which each team agrees. Make sure that all tasks are necessary as part of independent practice, have spaced practice and not massed practice, and align to the stated learning goals of the unit.
- **Homework answers:** There are many advantages to providing students with homework answers before the unit of instruction begins. When teachers provide students with answers to the homework problems, they can check their solutions against the answers, and if their end results do not match the provided answers, they can rework the problem to find their errors. In other words, students receive immediate and formative self-assessed feedback of their work—like when playing an electronic game. Moreover, a compelling reason to provide students with the answers to the homework in advance of the assignment is to save time during the class period the next day. No time should be spent going over the answers or the actual homework problems. Remember, homework is *independent* practice, not *in-class* practice. Since the students know exactly what they know and what they do not understand, any in-class discussion time on homework can be limited to a brief few minutes and becomes more meaningful for the students.

continued →



- **Homework focus in class:** Once each collaborative team determines homework, teachers can focus on how to address homework in class, the type of feedback that they will give students, and what will occur if students do not complete the homework. If teachers spend most of the class time going over homework, you lose the impact of successful independent practice on student learning. Students may be choosing to wait to do homework problems because they know they can write down the work when you go over the problems the next day. Since the purpose of homework is independent practice, limit the amount of time in class to grade, score, or go over the practice problems. If teachers spend most of the class time going over homework, each team must revisit the amount and content of what you assign. It could be that the team assigned too much homework or that students did not achieve an appropriate level of mastery prior to practice of the learning standard.

These homework processes and procedures should be consistent from teacher to teacher within each of your collaborative teams. Taking the time to monitor the quality of the homework assigned and how it is used in class is an important assessment issue and part of your leadership role in the school or district.

## Team Progress

It is helpful to diagnose your teams' current reality and provide feedback to help them take corrective action prior to launching the unit. Ask each team to individually assess its progress using the status check tool in table 1.5. It matters less what stage teams are at and more that members are committed to collaboratively defining the purpose of homework, using the same common homework assignments and protocols, and communicating those assignments to students, parents, and colleagues as your teams seek stage IV—sustaining.



**Table 1.5: Before-the-Unit-Begins Status Check Tool for HLTA 5—Planning and Using Common Homework Assignments**

<b>Directions:</b> Discuss your perception of your team's progress on the fifth high-leverage team action—planning and using common homework assignments. Defend your reasoning.			
<b>Stage I: Pre-Initiating</b>	<b>Stage II: Initiating</b>	<b>Stage III: Developing</b>	<b>Stage IV: Sustaining</b>
We do not have a clear purpose for why we assign homework.	We have <i>established</i> a clear purpose for homework, but it is not independent and formative student practice.	We have <i>developed</i> the shared purpose of using homework as independent formative student practice.	We have <i>implemented</i> the shared purpose of homework as independent formative student practice.
We do not plan or use common homework assignments and do not know the homework assignments given by other members of our team.	We discuss homework assignments and have not yet reached collaborative agreement on the nature of those assignments for each unit.	We collaboratively <i>plan</i> and develop common homework assignments for each unit.	We collaboratively <i>use</i> common homework assignments for each unit.
We do not know the nature of the homework protocols used for the assignments given by other members of our team.	We discuss the nature of the homework protocols used for the assignments given by other members of our team, but do not agree on those protocols.	We have team agreement on developed homework protocols including limited number of tasks, spaced practice, balance of cognitive demand, and alignment to the essential learning standards.	We have complete team agreement on homework protocols including limited number of tasks, spaced practice, balance of cognitive demand, and alignment to the essential learning standards, and we use those protocols with our students.
We do not know how other members of our team go over homework in class.	We discuss how we go over homework in class but do not agree on what we should do.	We discuss how we go over homework in class and agree on what we should do with homework during class.	We discuss how we go over homework in class, agree on what we should do, and implement that agreement.
We do not know how other members of our team count homework as a percent of the student's total grade.	We know how others count homework for a grade, but we each do it our own way.	We grade homework the same each day, but we count it differently from other team members as a percent of the total student grade.	We have complete team agreement on how homework should be used and accounted for as part of the student's total grade.

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## Setting Your Before-the-Unit Priorities for Team Action

When your school functions within a PLC culture, your grade- and course-level teams make the commitment to reach agreement on the five high-leverage team actions outlined in this chapter, and you have helped them in this endeavor.

- HLTA 1. Making sense of the agreed-on essential learning standards (content and practices) and pacing
- HLTA 2. Identifying higher-level-cognitive-demand mathematical tasks
- HLTA 3. Developing common assessment instruments
- HLTA 4. Developing scoring rubrics and proficiency expectations for the common assessment instruments
- HLTA 5. Planning and using common homework assignments

Your teams cannot focus on everything and will not have the time to do so for every unit. You should help your teams set priorities. You can use figure 1.19 to focus time and energy on actions that are most urgent in your teams' preparation for each unit during the year. Less is more. Focus on fewer things, and make those things matter at a deep level of team implementation.

These five high-leverage team actions combine to form step one of the teaching-assessing-learning cycle (see figure 1.1, page 10) and will help you prepare teams for the rigors and challenges of teaching and learning during the unit. They are also linked to teacher actions that will significantly impact student learning in each class.

In chapter 2, we turn our attention to steps two and three of the teaching-assessing-learning cycle and the mathematics instruction that takes place in your school or district. Here we focus on implementing in-class formative assessment processes through teaching strategies that include the use of higher-level-cognitive-demand mathematical tasks, common end-of-unit assessment instruments, and homework that is strongly connected and aligned to the learning standards for the unit.

<b>Directions:</b> Identify the stage you rated your team for each of the five high-leverage team actions, and provide a brief rationale. When you are ready, discuss your ratings as a team.				
1. Making sense of the agreed-on essential learning standards (content and practices) and pacing Stage I: Pre-Initiating      Stage II: Initiating      Stage III: Developing      Stage IV: Sustaining Reason: _____ _____ _____				
2. Identifying higher-level-cognitive-demand mathematical tasks Stage I: Pre-Initiating      Stage II: Initiating      Stage III: Developing      Stage IV: Sustaining Reason: _____ _____ _____				
3. Developing common assessment instruments Stage I: Pre-Initiating      Stage II: Initiating      Stage III: Developing      Stage IV: Sustaining Reason: _____ _____ _____				
4. Developing scoring rubrics and proficiency expectations for the common assessment instruments Stage I: Pre-Initiating      Stage II: Initiating      Stage III: Developing      Stage IV: Sustaining Reason: _____ _____ _____				
5. Planning and using common homework assignments Stage I: Pre-Initiating      Stage II: Initiating      Stage III: Developing      Stage IV: Sustaining Reason: _____ _____ _____				
With your collaborative team, respond to the red light, yellow light, and green light prompts for the high-leverage team actions that you and your team believe are most urgent.  <b>Red light:</b> Indicate one activity you will stop doing that limits effective implementation of each high-leverage team action.  <b>Yellow light:</b> Indicate one activity you will continue to do to be effective with each high-leverage team action.  <b>Green light:</b> Indicate one activity you will begin to do immediately to become more effective with each high-leverage team action.				

**Figure 1.19: Setting your collaborative team's before-the-unit priorities.**

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