TEACHING THROUGH PROBLEM-SOLVING

Teacher Self-Assessment Rubric

Teacher _____ **Grade Level** _____ **Date** _____

Directions: Highlight or mark phrases that describe your current situation or that you want to think about more.

Student View of Mathematics			
Student View of Mathematics	**Getting Started**	**Developing**	**Effective**
	Students: • Wait for the teacher to show how to solve a problem • Focus more on task completion than learning • Justify ideas using authority, or fail to justify • Do only the mathematics asked by the teacher; do not take initiative to learn or practice beyond what is asked • Little evidence of pride in work • Do not question the mathematics presented by teacher or classmates • Hesitant to share mistakes and conflicting ideas	Students: • Many students try to solve a problem by bringing in prior knowledge and tools, but may not be able to sustain throughout the lesson • Some students show behavior more like left column, some more like right column	Students: • Persist in problem-solving throughout lesson, drawing on prior knowledge, tools, and classmates' ideas to continue building and revising thinking • Justify using tools, models, observations, reasoning, prior knowledge • Are eager to share their thinking (even if incomplete). Willing to explore disagreements, learn from their mistakes, and update their own thinking. • Take pride in building and practicing their mathematical skills, and continuing to learn, even without prompting from the teacher. • Pose questions and come up with new problems on their own. • Express interest in solving novel problems and learning new content

Environment and Routines			
	Getting Started	**Developing**	**Effective**
Environment	• Seating or routines do not yet support all 3 lesson elements: independent work; partner chats; whole-class discussion. • Access to good writing surface and needed information (own tools, board, etc.) limits journal writing • Displays do not show current or prior knowledge developed by the class.	• Routines are emerging for all 3 lesson elements: independent work; partner chats; whole-class discussion. • Some students use board as resource for thinking or writing • Some students use reflective journals to record thinking, own work (from tools), ideas from board, etc.	• Seating and routines support all 3 lesson elements: independent problem-solving, partner chats, and whole class discussion focused on board. • Environmental supports for journal writing are in place throughout lesson: good writing surface; direct view of the board; view of own tools or other information to support thinking. • Displays from current or prior lessons allow students to reference knowledge developed by the class
The Board	• Board space is insufficient for whole lesson flow (problem, solution strategies, summary) or inconvenient for viewing by some students • The board may display some student or teacher work, but does not provide a coherent record of the lesson • Few students use the board to support their own reflection and writing	• Board does not fully capture the lesson flow (problem, student thinking, new mathematical idea) • Board is used by some students to make sense of mathematical ideas, reflect, or write what they learned	• Board visibility and size allows students to use board as a resource throughout a lesson and provides a coherent record of the lesson–the problem, how students thought about it, what they learned • Students use the board to make sense of mathematical ideas, to reflect on what they learned, and as model for notebook writing. • The board captures practices and models important to the lesson and grade (e.g., mathematical expression linked to model)

Student Journals	• Journals provide little insight into student thinking or student mathematical practices, since most information is copied from the board. • No evidence that students find journals useful as a reference tool or thinking tool • Teacher does not use student journal examples to highlight mathematical ideas or practices	• Some students value journals and find them useful • Journals provide some insight into student thinking	• Students take initiative to use their math journals throughout the lesson to record, organize, update, and reflect on their thinking. • Students find the journals useful; for example, they refer back to them, take care in their writing, and use journals to work out their thinking. • Teacher uses journal examples at the beginning of class to highlight mathematical ideas and practices useful to the class, and to help all students see the power of their mathematical thinking. • Student journals reveal reflection and meta-cognition; for example, students write about what helped them learn and about learning beyond board summary • Student journals evidence important mathematical habits such as writing mathematical expressions, drawing grade-level appropriate models, and updating thinking. • Students reveal learning in response to an open-ended journal prompt, e.g. “Reflections” rather than “What I Learned.” • Teacher finds the student journals useful in revealing student thinking

The Teaching Through Problem-Solving Lesson			
	Getting Started	**Developing**	**Effective**
Quality of Task	Mathematical Task: • Is an exercise that does not entail new mathematics. • Lacks entry points for some learners, or has heavy non-mathematical demands • Does not reveal how students think and reason • Does not fit within unit trajectory designed to support mastery of grade-level standards	Mathematical Task has some of the following characteristics, but not all: • Entails new mathematics • Is accessible to all students • Reveals how students think and reason • Fits within a unit trajectory designed to support mastery of grade-level standards.	Mathematical Task: • Enables students to learn new mathematics by solving and discussing the task. • Allows multiple entry points *to the mathematics* for different learners • Is likely to reveal student misunderstandings and misconceptions • Fits within a unit trajectory designed to support mastery of grade-level standards.
TTP Process	**Lesson Phase 1: Pose the Problem**		
	Students: • Wait for peers or teacher to tell them what to do • Do not actively try to make sense of problem Teacher: • Has not considered the prior knowledge students will draw on	Students: • Take some action to make sense of the problem, such as writing it down or considering what they know Teacher: • Has considered the prior knowledge students will draw on	Students: • Are eager to solve the problem themselves. • Activate their prior knowledge. • Ask themselves: “What is the new mathematics I will be tackling today?” Teacher: • Has considered the prior knowledge students will draw on and knows what individual students know

TTP Process	Lesson Phase 2: Independent Problem-Solving		
	Students: • Do not get started • Do not seem to think about what the problem means or what relevant knowledge they have • Focus on "what the teacher wants us to do" or copy peers' work • Tend to stop working when they are stuck. • Do not look back on their work or try to correct it	Students: • Try to solve the problem, but have trouble sustaining their effort • Some students show the habits listed in the left column, some show the habits listed in the right column	Students: • Bring their own knowledge and skills to bear on the problem. • Focus on what they want to learn or figure out • Try to find entry point to a problem they don't yet know how to solve. • Recognize what they understand and where they are stuck. • Exert effort and demonstrate perseverance, • Evaluate their work and attempt to correct mistakes on their own.
	The Teacher: • Spends time in extended work with individual students, rather than noting down all students' strategies • Guides struggling students step by step • Does not plan which strategies will be presented to class • Provides heavy scaffolding that feeds a solution procedure to students	The Teacher: • Expects students will solve problem independently, but actions do not fully support this. For example, may scaffold struggling students too heavily or fail to note down all students' strategies.	The Teacher: • Notes down strategies used by individuals; strategically identifies students to present during whole-class discussion • Expresses confidence in the students' abilities to solve mathematical problems independently. • Notices students who are "stuck" and intervenes in ways that still enable the students to do the important mathematical thinking. • Models questions students can learn to ask themselves, such as "What is the problem asking? What do the numbers mean?"

TTP Process	Phase 3: Presentation and Discussion		
	Students: • Present ideas in a way that is hard for classmates to see, hear, or understand • Show little interest in strategies presented by classmates; do not question classmates or update their own work based on class discussion • Do not connect, contrast, or integrate ideas presented by classmates	Students: • Show some capacity to present their ideas, and some interest in strategies presented by classmates • Some student presentations may be rambling accounts or "blow-by-blow" procedure descriptions, rather than showing reasoning • Routines for discussing student work (connecting, contrasting, etc.) are emerging	Students: • Present strategies at the board in a way that can be seen, heard, and understood by classmates; clear, concise, audible speech and clear visuals (drawn by student or teacher). • Actively try to make sense of the solution strategies presented by classmates, extract key mathematical points, and update their own work as needed. • Actively look for connections and differences across classmates' presentations.
	The Teacher: • May not have clear strategy for choice of student work and ideas to be drawn from the student work • Lesson ends with "show and tell" of student work	The Teacher: • Strategically chooses student work for presentation • Sparks some discussion about the mathematical thinking and reasoning behind the solutions • Sparks some discussion connecting or contrasting the student work	The Teacher: • Strategically chooses student work for presentation • Uses student-led questioning routines or teacher questions to spark discussion about the mathematical thinking and reasoning behind the solutions • Supports discussion in which students connect, contrast, and synthesize ideas, making a bridge from prior knowledge to the new mathematics
	Lesson Phase 4: Summary and Reflection		
	• No summary of what was learned, or teacher-made summary that may not reflect student thinking. • Students do not reflect on what they learned during the lesson	• Students reflect on what they learned, but there is a gap between what they learned and what the teacher hoped they would learn	• Teacher elicits student ideas about what has been learned, and uses this information to write lesson summary on the board. • Students record the lesson summary in their journals. • Students also write individual reflections in journals, capturing information such as what they learned, the process that helped them learn, what they want to learn next, or other information that builds their meta-cognition and identity as problem-solvers.

Tools and Models Essential to Your Grade Level*			
Tools and Models Essential to Your Grade Level	**Getting Started**	**Developing**	**Effective**
	• Our grade level has not yet identified the essential tools and models students need to master this year • Many students rely on the most basic tools/models (such as counting on fingers, drawing individual items), rather than tools that might offer more support for future mathematical learning • Few students have reliable, efficient tools/models to support their reasoning, explanation, and checking of mathematical ideas • Students cannot access the tools independently; I pass them out	• I am not completely clear on how/when to introduce specific models/tools or their importance • Students are developing understanding of some tools/models that are important to future learning or provide strong visual support for mathematical ideas • Students sometimes initiate use of the important tools and models when explaining, reasoning, or checking thinking	• I am clear on what tools/ models students need to develop this year, when, and why; our grade-level tools/models connect to a coherent school-wide strategy • The whole class shares an understanding of the tools and models, so they can be used effectively in whole-class discussion • Large tools/models can easily be seen by all students during whole-class discussion • All students can reliably use the tools/models to reason, explain and check thinking • Students "own" the tools/models and routinely access them independently

* We use "tool" to mean a physical object and "model" to mean something students (or teachers) draw. Tools (such as unit blocks and ten-frames) and models (such as a tape diagram) can both provide bridges between a concrete situation (such as adding 9 apples and 4 apples) and an abstract mathematical expression (such as 9+4).

Based on study of your own curriculum and standards, it is good to agree as a school on what are the key tools and models students should master at each grade level. For example, what mathematical expressions will students be able to write and what diagrams will they be able to draw at each grade? What tools are essential to your program, and how will they be built upon in important ways in future years? What are optional?

Ideally, tools and models support mathematics learning in the following ways:

- **Help students reason, check and explain their thinking**. To work for explaining, the class must have a shared understanding of the tool or model and students must be able to use it reliably.
- **Provide strong visual support for the key ideas at each grade level, and provide coherence across grades**. For example, 10 reversible tiles that fit into a ten-frame help students see the ways to compose-decompose 10 in kindergarten. The same ten-frame, with additional unit tiles, helps students see teen numbers as "10 and some more" in grade 1, and see 10 as a component of larger numbers in later grades.