

***Instructional Implementation Sequence:
Attaining the CCSS Mathematical Practices***

Engagement Strategies			
Strategy	Description	CCSS Math Practices	Student Actions
Partner Conversations	Turn and Talk, Team Mates Consult, Pair-Share, or Think-Pair-Share, are engagement strategies easy to implement in any classroom at any grade level or subject. Partner conversations do not require any change in pedagogy or materials. For pair – share, teachers merely ask a question or assign a problem and allow students to think and work with a partner for one to three minutes before requesting an answer to the question or problem. In think – pair – share students are given a brief period of time to think independently before working with a partner. These strategies are a significant first step in engaging all students in classroom instructional activities.	• Make sense of problems.	• Explain their thought processes in solving a problem one way.
		• Critique the reasoning of others.	• Understand and discuss other ideas and approaches.
Showing thinking in classrooms	Teachers need to work toward higher degrees of student involvement in classroom activities. Once pair – share is incorporated into classroom routines, teachers need to incorporate additional strategies that promote “every pupil response” (EPR). EPR strategies include such responses as “thumbs up/thumbs down,” or use of individual white boards for noting answers. Students are also pressed to be more aware of their thinking and express their thinking in more detail. Students are routinely asked to share their thinking in mathematics classrooms. However, what is routinely accepted as thinking is actually process description. Students merely provide the steps they used to solve the problem, not their reasoning and thinking about how they knew which processes to use. In order to reveal student thinking, more challenging, open-ended problems are needed.	• Construct viable arguments.	• Explain their thinking for the solution they found.
		• Attend to precision.	• Communicate their reasoning and solution to others.
Questioning and wait time	As thinking is increased in mathematics classroom, better questioning and wait time are required. Teachers need to provide thought provoking questions to students, and then allow the students time to think and work toward an answer. <i>* Typically a teacher waits less than one second to respond to a question posed to students. Research shows that under these conditions students generally give short, recall responses or no answer at all rather than giving answers that involve higher-level thinking. Studies show that if teachers pause between three and seven seconds after asking higher-level questions, students respond with more thoughtful answer.</i>	• Make sense of problems.	• Explain their thought processes in solving a problem in several ways.
		• Persevere in solving them.	• Stay with a challenging problem for more than one attempt.
		• Construct viable arguments.	• Explain their thinking with accurate vocabulary both their own thinking and thinking of others.
		• Critique the reasoning of others.	• Explain other student’s solutions and identify strengths and weaknesses of the solution.

Empowerment Strategies			
Strategy	Description	CCSS Math Practices	Student Actions
Grouping and engaging problems	The strategy of “grouping and engaging problems” is a significant shift in pedagogy and materials. Students are given challenging problems to work, and allowed to work on the problem in a group of two, three, or four. Challenging mathematics problems take time, effort, reasoning, and thinking to solve.	<ul style="list-style-type: none"> • Make sense of problems. 	Discuss, explain, and demonstrate solving a problem with multiple representations and in multiple ways.
		<ul style="list-style-type: none"> • Persevere in solving them. 	<ul style="list-style-type: none"> • Try several approaches in finding a solution, and seek only hints if stuck.
		<ul style="list-style-type: none"> • Reason abstractly and quantitatively. 	<ul style="list-style-type: none"> • Reason with models or pictorial representations to solve problems.
		<ul style="list-style-type: none"> • Reason abstractly and quantitatively. 	<ul style="list-style-type: none"> • Translate situations into symbols for solving problems.
		<ul style="list-style-type: none"> • Construct viable arguments. 	<ul style="list-style-type: none"> • Justify and explain, with accurate language and vocabulary, why their solution is correct.
		<ul style="list-style-type: none"> • Critique the reasoning of others. 	<ul style="list-style-type: none"> • Compare and contrast various solution strategies and explain the reasoning of others.
		<ul style="list-style-type: none"> • Model with mathematics. 	<ul style="list-style-type: none"> • Use models to represent and solve a problem, and translate the solution to mathematical symbols.
		<ul style="list-style-type: none"> • Use appropriate tools strategically. 	<ul style="list-style-type: none"> • Use the appropriate tool to find a solution.
		<ul style="list-style-type: none"> • Use appropriate tools strategically. 	<ul style="list-style-type: none"> • Select from a variety of tools the ones that can be used to solve a problem, and explain their reasoning for the selection.
		<ul style="list-style-type: none"> • Look for and express regularity in repeated reasoning. 	<ul style="list-style-type: none"> • Look for patterns, and use if, then reasoning strategies for obvious patterns.

Empowerment Strategies con't			
Strategy	Description	CCSS Math Practices	Student Actions
Using questions and prompts with groups	Once students are provided with opportunities to solve challenging problems in groups, teachers need to increase their ability to ask supporting questions that encourage students to continue working, provide hints or cues without giving students the answers, and ask probing questions to better assess student thinking and current understanding.	• Model with mathematics.	• Use models and symbols to represent and solve a problem, and accurately explain the solution representation.
		• Look for and make use of structure.	• Look for structure within mathematics to help them solve problems efficiently.
Allowing students to struggle	Students learn to persevere in solving challenging mathematics problems by being allowed to struggle with challenging problems. Students need to understand that mathematical problems do not usually have a quick, easy solution. Effective effort is a life-skill and should be learned interdependently and independently. Appropriate degree of difficulty is foremost on teachers' minds. If the problem is too easy, students do not need to struggle. If the problem is far too difficult, students are not capable of solving the problem. Teachers need to balance working in groups and working independently, and be able to quickly adjust grouping strategies as the need arises.	• Persevere in solving them.	• Struggle with various attempts over time, and learn from previous solution attempts.
		• Model with mathematics.	• Use a variety of models, symbolic representations, and technology tools to demonstrate a solution to a problem.
		• Use appropriate tools strategically.	• Combine various tools, including technology, explore and solve a problem as well as justify their tool selection and problem solution.
		• Attend to precision.	• Incorporate appropriate vocabulary and symbols in communicating their reasoning and solution to others.
		• Look for and make use of structure.	• Compose and decompose number situations and relationships through observed patterns in order to simplify solutions.

		<ul style="list-style-type: none"> • Look for and express regularity in repeated reasoning. 	<ul style="list-style-type: none"> • Find and explain subtle patterns.
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Empowerment Strategies con't			
Encouraging reasoning	<p>Students need to be encouraged to carefully think about mathematics, and to understand their level of knowledge. They also need to be able to accurately communicate their thinking. Reasoning, in this context, is used to convey having students stretch their understanding and knowledge to solve challenging problems. Reasoning requires students to pull together patterns, connections, and understandings about the rules of mathematics, and then apply their insight into finding a solution to a difficult, challenging problem.</p>	<ul style="list-style-type: none"> • Reason abstractly and quantitatively. 	<ul style="list-style-type: none"> • Convert situations into symbols to appropriately solve problems as well as convert symbols into meaningful situations.
		<ul style="list-style-type: none"> • Attend to precision. 	<ul style="list-style-type: none"> • Use appropriate symbols, vocabulary, and labeling to effectively communicate and exchange ideas.
		<ul style="list-style-type: none"> • Look for and make use of structure 	<ul style="list-style-type: none"> • See complex and complicated mathematical expressions as component parts.
		<ul style="list-style-type: none"> • Look for and express regularity in repeated reasoning. 	<ul style="list-style-type: none"> • Discover deep, underlying relationships, i.e. uncover a model or equation that unifies the various aspects of a problem such as discovering an underlying function.