

Stem Questions to Promote the 8 Mathematical Practices

Math Practices	Proficiency Matrix*	Questions to Promote**
Make Sense of Problems & persevering in solving them Encouraging students to continue working	<ol style="list-style-type: none"> 1. Explain their processes in solving a problem one way 2. Explain their thought processes in solving a problem and representing it in several ways 3. Discuss, explain, and demonstrate solving a problem with multiple representations and in multiple ways <ol style="list-style-type: none"> 1. Stay with a problem for more than one attempt 2. Try several approaches in finding a solution, and only seek hints if stuck 3. Struggle with various attempts over time, and learn from previous solution attempts 	<ul style="list-style-type: none"> • What do you think about what _____ said? • Do you agree? Why or why not? • Does anyone have the same answer but a different way to explain it? • Do you understand what _____ is saying? • Have you compared your work with anyone else's? • What did other members of your group try? • How would you describe the problem in your own words? • What do you know that is not stated in the problem? • How do you tackle similar problems? • Could you try it with different numbers? • What about putting things in order?
Reason abstractly and quantitatively Checking for student understanding	<ol style="list-style-type: none"> 1. Reason with models or pictorial representations to solve problems 2. Are able to translate situations into symbols for solving problems 3. Convert situations into symbols to appropriately solve problems as well as convert symbols into meaningful situations 	<ul style="list-style-type: none"> • Can you explain what you have done so far? • What else is there to do? • Why did you decide to use this method? • Can you think of another method that might have worked? • Is there a more efficient strategy? • What did you notice? • Why did you decide to organize your results like that? • Do you think this may work with other numbers? • Have you thought of all the possibilities? How can you be sure?
Construct viable arguments & critiquing the reasoning of others Build confidence to help students rely on their own understanding	<ol style="list-style-type: none"> 1. Explain their thinking for the solution they found 2. Explain their own thinking and thinking of others with accurate vocabulary 3. Justify and explain, with accurate language and vocabulary, why their solution is correct. <ol style="list-style-type: none"> 1. Understand and discuss other ideas and approaches 2. Explain other students/solutions and identify strengths and weaknesses of the solution 3. Compare and contract various solution strategies and explain the reasoning of others 	<ul style="list-style-type: none"> • How did you reach that conclusion? • Does that make sense? • Can you make a model to show that? • Why is that true?
Model with mathematics	<ol style="list-style-type: none"> 1. Use models to represent and solve a problem, and translate the solution to mathematical symbols 2. Use models and symbols to represent and solve a problem, and accurately explain the solution representation 3. Use a variety of models, symbolic representations, and technology tools to demonstrate a solution to a problem 	<ul style="list-style-type: none"> • Would it help to create a diagram? Draw a picture? Make a table? • Can you guess and check?

*Proficiency Matrix Key:

1 = Initial Stage

2= Intermediate Stage

3=Advance Stage

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Use appropriate tools strategically	<ol style="list-style-type: none"> 1. Use the appropriate tool to find a solution 2. Select from a variety of tools the ones that can be used to solve a problem, and explain their reasoning for the selection 3. Combine various tools, including technology, explore and solve a problem as well as justify their tool selection and problem solution 	<ul style="list-style-type: none"> • What tool could you use to find your answer? • Is there another tool you could use? • Why did you use this method to solve the problem?
Attend to precision Encouraging reflection	<ol style="list-style-type: none"> 1. Communicate their reasoning and solution to others 2. Incorporate appropriate vocabulary and symbols in others 3. Use appropriate symbols, vocabulary, and labeling to effectively communicate and exchange ideas 	<ul style="list-style-type: none"> • How did you get your answer? • Does your answer seem reasonable? Why or why not? • Can you describe your method to us all? Can you explain why it works? • What if you had started with _____ rather than _____? • What if you could only use _____? • What have you learned or found out today? • Did you use or learn any new words today? What do they mean? • What are the key points or big ideas in this lesson?
Look for and make use of structure Making connections between other mathematical ideas and applications	<ol style="list-style-type: none"> 1. Look for structure within mathematics to help them solve problems efficiently (such as $2 \times 7 \times 5$ has the same value as $2 \times 5 \times 7$, which is $(2 \times 7) \times 5$, the student can mentally calculate 10×7). 2. Compose and decompose number situations and relationships through observed patterns in order to simplify solutions 3. See complex and complicated mathematical expressions as component parts 	<ul style="list-style-type: none"> • How does this relate to...? • What concepts that we have learned before were useful in solving this problem? • What uses of mathematics did you find in the newspaper last night? • Can you give an example of...?
Look for and express regularity in repeated reasoning Help students to reason mathematically	<ol style="list-style-type: none"> 1. Look for obvious patterns, and use if/then reasoning strategies for obvious patterns 2. Find and explain subtle patterns 3. Discover deep, underlying relationships, i.e. uncover a model or equation that unifies the various aspects of a problem such as discovery of an underlying function. 	<ul style="list-style-type: none"> • Is that true for all? Explain • Can you think of a counter example? • How would you prove that? • What assumptions are you making?

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