The Standards for Mathematical Practice: Student and Teacher Actions and Related Questions

Mathematical Practice	Student Actions	Teacher Actions	Related Questions
1. Make sense of problems and persevere in solving them	• Have or value sense-making • Use patience and persistence to listen to others • Be able to use and make sense of strategies • Monitor progress and change course, if needed • Be able to show, use, and explain representations and use them to solve problems • Communicate, verbally and in written format • Be able to deduce what is a reasonable solution in the context of the problem	• Provide open-ended and rich problems • Ask probing questions • Model multiple problem-solving strategies through Think- Alouds • Promote and value discourse, collaboration, and student presentations • Provide cross-curricular integrations • Probe student responses (correct or incorrect) for understanding of approaches • Provide solutions	• How would you describe the situation in your own words? • How would you describe what you are trying to find? • What diagram or manipulatives can you use to make sense of what you need to do? • What information is given in the problem? • What is the relationship between the quantities? • Describe what you have already tried. What might you change? • Talk through the steps you've used to this point. • What steps in the process are you most confident about? • What are some other strategies you might try? • How might you use one of your previous problems to help you begin? • How else might you organize...represent... show...?
2. Reason abstractly and quantitatively	• Make sense of and explain quantities and relationships in problem situations • Create and explain multiple representations • Create and explain equivalent expressions or equations • Use context to reason about an operation, an answer or the units of the answer • Translate from abstract to context & vise versa • Estimate first/check if answer reasonable • Make connections • Consider whether strategies are efficient • Take time and make effort to reason	• Develop opportunities for problem solving • Provide opportunities for students to listen to the reasoning of other students • Give time for processing and discussing • Tie content areas together to help make connections • Ask students to explain their reasoning • Think aloud for student benefit • Value the path to developing efficient strategies • Emphasize reasoning, not just answer getting	• What do the numbers used in the problem represent? • What is the relationship of the quantities? • What is a reasonable answer to this problem? How do you think about that? • How is _____ related to _____? • What is the relationship between _____and _____? • What does_____ mean to you? (e.g. symbol, quantity, diagram) • What properties might we use to find a solution? • How did you decide in this task that you needed to use...? • Could we have used another operation or property to solve this task? Why/why not? • Why does that make sense?
3. Construct viable arguments and critique the reasoning of others	• Ask questions of students and teacher • Justify and communicate predictions and conclusions • Use examples and non-examples • Analyze data, use to make arguments • Use objects, drawings, diagrams, and actions • Use mathematics vocabulary, properties, and definitions in support of statements • Listen and respond to others • Build on other students' ideas • Question and comment on other's work/ideas	• Create a safe environment for risk-taking and critiquing with respect • Model each key student disposition • Provide complex, rigorous tasks that foster deep thinking • Provide time for student presentations and student-to student discourse • Plan effective questions and student grouping • Ask students to agree, disagree, support and compare the ideas of others	• What mathematical evidence would support your solution? • How can we be sure that...? / How could you prove that...? • Will it still work if...? • What were you considering when...? • How did you decide to try that strategy? • How did you test whether your approach worked? • How did you decide what the problem was asking you to find? • Did you try a method that did not work? Why didn't it work? Could it work? • What is the same and what is different about...? • How could you demonstrate a counter-example?
4. Model with mathematics	• Use mathematics (numbers and symbols) to solve/work out real-life situations • Mathematize situations using numbers, symbols, equations, tables, graphs, or formulas • Pull out important information needed to solve a problem when approached with several factors in everyday situations • Make sense of the symbols and quantities in an equation or function (as they relate to the context)	• Allow time for the process to take place (equations, graphs, etc.) • Stress the importance of connecting the context, equations, tables and/or graphs • Emphasize sense making between a context, symbols and quantities in an equation • Provide meaningful, real world, authentic, performance-based tasks (non traditional word problems)	• How can you use numbers to represent the problem? • What are some other ways to represent the quantities? • What is an equation or expression that matches the diagram, number line, chart, table, or your actions with the manipulatives? Is there more than one equation? • Where did you see one of the quantities in the task in your equation or expression? What does each number in the equation mean? • How would it help to create a diagram, graph, table...? • What are some ways to visually represent...? • What formula might apply in this situation?

Mathematical Practice	Student Actions	Teacher Actions	Related Questions
5. Use appropriate tools strategically	• Choose the appropriate tool to solve a given problem and deepen conceptual understanding (paper/pencil, ruler, base 10 blocks, compass, protractor) • Choose the appropriate technological tool to solve a given problem and deepen conceptual understanding (e.g., spreadsheet, geometry software, calculator, web 2.0 tools) • Use technology to explore mathematical situations • Know to examine answers from calculators or software programs for reasonableness	• Maintain knowledge of appropriate tools • Make tools available for student selection • Model use of the tools available, their benefits and limitations • Scaffold the understanding and use of more complex tools • Model a situation where the decision needs to be made as to which tool should be used • Provide tasks that require students to use manipulatives, calculators or software programs to develop conceptual understanding, solve problems, or predict solutions.	• What mathematical tools can we use to visualize and represent the situation? • Which tool is more efficient? Why do you think so? • What does (a manipulative) represent? • How can (the tool) help you understand the situation/estimate the answer/find a solution? • In this situation would it be helpful to use a graph, a number line, a ruler, a diagram, a calculator, or a manipulative? • Why was it helpful to use...? • What can using a _____ show us that _____may not? • In what situations might it be more informative or helpful to use...? • Does your answer (from calculator or computer) make sense?
6. Attend to precision	• Communicate with precision-orally and written • Use mathematics concepts and vocabulary appropriately. • State meaning of symbols; use appropriately • Attend to units/labeling/tools accurately • Carefully formulate explanations • Calculate accurately and efficiently • Express answers in terms of context • Formulate precise definitions with others • Use journals or class charts as reference	• Model Think aloud/Talk aloud • Give explicit instruction through the use of think aloud/talk aloud • Guide inquiry: teacher gives problem, students work together to solve problems, and time is given for discussing/sharing/comparing • Ask probing questions related to the content • Ask for more specificity about an explanation • Have materials available for students to use as reference (journals, charts, books, etc.)	• What mathematical terms apply in this situation? • How did you know your solution was correct? • Explain how you might show that your solution answers the problem. • How are you showing the meaning of the quantities? • What symbols or mathematical notations are important in this problem? • What mathematical language...,definitions..., properties can you use to explain...? • How could you test your solution to see if it answers the problem? • When you said _____, what did you mean?
7. Look for and make use of structure	• Look for, interpret, and identify patterns and structures • Make connections to skills and strategies previously learned to solve new problems/tasks • Reflect and recognize various structures in mathematics • Breakdown complex problems into simpler, more manageable chunks	• Be quiet and allow students to think aloud • Facilitate learning by using open-ended questioning to assist students in exploration • Carefully select tasks that allow for students to make connections • Allow time for student discussion and processing • Foster persistence/stamina in problem solving • Provide graphic organizers or record student responses strategically to allow students to discover patterns	• What observations do you make about...? • What do you notice when...? • What parts of the problem might you eliminate..., simplify...? • What patterns do you find in...? • How do you know if something is a pattern? • What ideas that we have learned before were useful in solving this problem? • What are some other problems that are similar to this one? • How does this relate to...? • In what ways does this problem connect to other mathematical concepts?
8. Look for and express regularity in repeated reasoning	• Identify patterns and make generalizations • Continually evaluate reasonableness of intermediate results • Maintain oversight of the process	• Provide rich and varied tasks that allow students to generalize relationships and methods, and build on prior math knowledge • Provide adequate time for exploration • Provide time for dialogue and reflection • Ask deliberate questions that enable students to reflect on their own thinking • Create strategic and intentional check-in points during student work time	• Explain how this strategy works in other situations? • Is this always true, sometimes true or never true? • How would we prove that...? • What do you notice about...? • What is happening in this situation? • What would happen if...? • Is there a mathematical rule for...? • What predictions or generalizations can this pattern support? • What mathematical consistencies do you notice?