Standards for Mathematical Practice

**SMP 1 MAKE SENSE OF PROBLEMS AND PERSEVERE IN SOLVING THEM**

**TEACHER**
- a. Structures activities in ways that allow students to make meaning of, explore, analyze, plan a solution pathway, monitor, explain, extend, and evaluate their progress.
- b. Poses complex, challenging problems that do not have an obvious solution or solution process.
- c. Provides appropriate feedback allowing students to think and persevere through the problem-solving process.
- d. Allows students to consider and understand various approaches, including considering analogous problems, transforming algebraic expressions, and using concrete objects or pictures, to solve complex problems.
- e. Provides opportunities to identify correspondences between different approaches. Provides students opportunities to make connections to prior knowledge.
- f. Provides appropriate resources that allow students to conceptualize their ideas.

**STUDENT**
- a. Explains the meaning of a problem and looks for entry points to its solution.
- b. Analyzes given constraints, relationships, and goals.
- c. Articulates formal and informal arguments, and plans a solution pathway rather than simply jumping into a solution attempt.
- d. Considers analogous problems, and tries special cases and simpler forms of the original problem in order to gain insight into its solution.
- e. Monitors and evaluates their progress and changes course if necessary.
- f. Transforms algebraic expressions or changes the viewing window on their graphing calculator to get needed information (depending on the context of the problem).
- g. Checks answers to problems using different methods.
- h. Asks, “Does this make sense?”
- i. Understands the approaches of others to solve complex problems and identify correspondences between different approaches.

**SMP 2 REASON ABSTRACTLY AND QUANTITATIVELY**

**TEACHER**
- a. Provides opportunities for students to reason in both concrete and abstract terms:
  - Example: creates problems that require students to make sense of quantities and relationships and attend to the meaning of those quantities.
- b. Brings two complementary abilities to bear on problems involving quantitative relationships:
  - the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents.
  - the ability to contextualize—to pause as needed during the manipulation process in order to probe into the referents for the symbols involved.
- c. Creates coherent representations of the problem, considering the units involved and attending to the meaning of quantities, not just how to compute them.
- d. Knows and flexibly uses different properties of operations and objects.

**STUDENT**
- b. Identifies important quantities in a practical situation and represents it symbolically.
- c. Identifies important quantities in a practical situation and maps their relationships using tools such as diagrams, two-way tables, graphs, flowcharts and formulas.
- d. Analyzes relationships mathematically to draw conclusions.
- e. Interprets mathematical results in the context of the situation and reflects on whether they make sense, possibly improving the model if it has not served its purpose.

**SMP 3 CONSTRUCT VIABLE ARGUMENTS AND CRITIQUE THE REASONING OF OTHERS**

**TEACHER**
- a. Encourages students to propose, defend, and assess sound and logical arguments based on mathematical reasoning.
- b. Provides opportunities for students to interact in ways that support and challenge their strategic thinking.
- c. Monitors and evaluates their progress and changes course if necessary.
- d. Monitors and evaluates their progress and changes course if necessary.

**STUDENT**
- a. Understands and uses stated assumptions, definitions, and previously established results to construct arguments.
- b. Conjectures and builds a logical progression of statements to explore the truth of their conjectures.
- c. Monitors and evaluates their progress and changes course if necessary.
- d. Monitors and evaluates their progress and changes course if necessary.
- e. Justifies conclusions, communicates them to others, and responds to the arguments of others.
- f. Monitors and evaluates their progress and changes course if necessary.
- g. Monitors and evaluates their progress and changes course if necessary.
- h. Monitors and evaluates their progress and changes course if necessary.

**SMP 4 MODEL WITH MATHEMATICS**

**TEACHER**
- a. Draws on real-world situations in which students need to come up with mathematical approaches to solve problems (as opposed to typical word problems in which the mathematical approach is obvious).
- b. Helps students understand how mathematics might be used to solve problems and explore possible mathematical approaches (e.g. making predictions, analyzing assumptions, making connections to prior knowledge, making estimations, analyzing relationships).
- c. Monitors and evaluates their progress and changes course if necessary.
- d. Monitors and evaluates their progress and changes course if necessary.
- e. Interprets mathematical results in the context of the situation and reflects on whether they make sense, possibly improving the model if it has not served its purpose.

**STUDENT**
- a. Applies the mathematics they know to solve problems arising in everyday life, society, and the workplace.
- b. Feels comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.
- c. Identifies important quantities in a practical situation and maps their relationships using tools such as diagrams, two-way tables, graphs, flowcharts and formulas.
- d. Monitors and evaluates their progress and changes course if necessary.
- e. Monitors and evaluates their progress and changes course if necessary.
### SMP 5  USE APPROPRIATE TOOLS STRATEGICALLY

**TEACHER**
- a. Makes tools accessible to students and provides opportunities for students to choose and justify the use of the appropriate tool.
- b. Provides opportunities for students to practice with various tools in various contexts in order for students to make sound decisions about when these tools should be used.

**STUDENT**
- a. Considers tools when solving mathematical problems. These tools might include pencil and paper, concrete models, rulers, protractors, calculators, spreadsheets, computer algebra systems, statistical packages, or dynamic geometry software.
- b. Knows about tools appropriate for their grade or course and makes sound decisions about when each tool might be useful, recognizing both the insight to be gained and their limitations.
- c. Identifies relevant external mathematical resources, such as digital content located on websites, and uses them to pose or solve problems.
- d. Uses technological tools to explore and deepen understanding of concepts.

### SMP 6  ATTENDS TO PRECISION

**TEACHER**
- a. Models and encourages precise mathematical language in oral communication and in writing.
- b. Emphasizes accuracy and precision in calculations and measurements.

**STUDENT**
- a. Tries to communicate precisely with others.
- b. Tries to use clear definitions in discussions with others and in their own reasoning.
- c. States the meaning of the symbols they choose, including using the equal sign consistently and appropriately.
- d. Are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem.
- e. Calculates accurately and efficiently, expresses numerical answers with a degree of precision appropriate for the problem context.
- f. Gives carefully formulated explanations to other students. Note: applicable in elementary grades
- g. Examines claims and makes explicit use of definitions. Note: applicable by high school

### SMP 7  LOOK FOR AND MAKE USE OF STRUCTURE

**TEACHER**
- a. Provides opportunities for students to look for patterns within structures that will help them solve problems or understand mathematical concepts.
- b. Provides opportunities for students to make connections and see relationships between related structures.
  - Example 1. Relationships between tables, graphs, diagrams, equations, and contextual situations.
  - Example 2. Relationships between fraction form, decimal form, percent form.
  - Example 3. Relationships between shortcut notations and expanded notations.
  - Example 4. Relationships between other types of structures in mathematics.

**STUDENT**
- a. Looks closely to discern a pattern or structure.

### SMP 8  LOOK FOR AND EXPRESS REGULARITY IN REPEATED REASONING

**TEACHER**
- a. Provides opportunities for students to make generalizations based on reoccurring observations and patterns, create shortcuts, and flexibly go back and forth between the two.

**STUDENT**
- a. Notices if calculations are repeated.
- b. Looks for general methods and for shortcuts.