1 Make sense of problems and persevere in solving them.
Mathematically proficient students:
• explain to themselves the meaning of a problem and looking for entry points to its solution.
• analyze givens, constraints, relationships, and goals.
• make conjectures about the form and meaning of the solution attempt.
• consider analogous problems, and try special cases and simpler forms of the original problem.
• monitor and evaluate their progress and change course if necessary.
• transform algebraic expressions or change the viewing window on their graphing calculator to get information.
• explain correspondences between equations, verbal descriptions, tables, and graphs.
• draw diagrams of important features and relationships, graph data, and search for regularity or trends.
• use concrete objects or pictures to help conceptualize and solve a problem.
• check their answers to problems using a different method.
• ask themselves, “Does this make sense?”
• understand the approaches of others to solving complex problems.

2. Reason abstractly and quantitatively.
Mathematically proficient students:
• make sense of quantities and their relationships in problem situations.
  ✓ decontextualize (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 and
  ✓ contextualize (pause as needed during the manipulation process in order to probe into the referents for the symbols involved).
• use quantitative reasoning that entails creating a coherent representation of quantities, not just how to compute them
• know and flexibly use different properties of operations and objects.

3 Construct viable arguments and critique the reasoning of others.
Mathematically proficient students:
• understand and use stated assumptions, definitions, and previously established results in constructing arguments.
• make conjectures and build a logical progression of statements to explore the truth of their conjectures.
• analyze situations by breaking them into cases
• recognize and use counterexamples.
• justify their conclusions, communicate them to others, and respond to the arguments of others.
• reason inductively about data, making plausible arguments that take into account the context
• compare the effectiveness of plausible arguments
• distinguish correct logic or reasoning from that which is flawed
  ✓ elementary students construct arguments using objects, drawings, diagrams, and actions..
  ✓ later students learn to determine domains to which an argument applies.
• listen or read the arguments of others, decide whether they make sense, and ask useful questions

4 Model with mathematics.
Mathematically proficient students:
• apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.
  ✓ In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community.
  ✓ By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another.
• simplify a complicated situation, realizing that these may need revision later.
• identify important quantities in a practical situation
• map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas.
• analyze those relationships mathematically to draw conclusions.
• interpret their mathematical results in the context of the situation.
• reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5 Use appropriate tools strategically.
Mathematically proficient students
• consider available tools when solving a mathematical problem.
• are familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools
• detect possible errors by using estimations and other mathematical knowledge.
• know that technology can enable them to visualize the results of varying assumptions, and explore consequences.
• identify relevant mathematical resources and use them to pose or solve problems.
• use technological tools to explore and deepen their understanding of concepts.

6  **Attend to precision.**
Mathematically proficient students:
• try to communicate precisely to others.
• use clear definitions in discussion with others and in their own reasoning.
• state the meaning of the symbols they choose, including using the equal sign consistently and appropriately.
• specify units of measure and label axes to clarify the correspondence with quantities in a problem.
• calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the context.
  ✓ In the elementary grades, students give carefully formulated explanations to each other.
  ✓ In high school, students have learned to examine claims and make explicit use of definitions.

7  **Look for and make use of structure.**
Mathematically proficient students:
• look closely to discern a pattern or structure.
  ✓ Young students might notice that three and seven more is the same amount as seven and three more.
  ✓ Later, students will see $7 \times 8$ equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for the distributive property.
  ✓ In the expression $x^2 + 9x + 14$, older students can see the 14 as $2 \times 7$ and the 9 as $2 + 7$.
• step back for an overview and can shift perspective.
• see complicated things, such as some algebraic expressions, as single objects or composed of several objects.

8  **Look for and express regularity in repeated reasoning.**
Mathematically proficient students:
• notice if calculations are repeated
• look both for general methods and for shortcuts.
• maintain oversight of the process, while attending to the details.
• continually evaluate the reasonableness of intermediate results.

**STANDARDS FOR MATHEMATICAL CONTENT**

6\textsuperscript{th} grade content standards:
• Understand ratio concepts and use ratio reasoning to solve problems

7\textsuperscript{th} grade content standards:
• Analyze proportional relationships and use them to solve real-world and mathematical problems.
• Draw, construct and describe geometrical figures and describe the relationships between them.

8\textsuperscript{th} grade geometry content standards:
*Understand congruence and similarity using physical models, transparencies, or geometry software.*

1. Verify experimentally the properties of rotations, reflections, and translations.
2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.