

# MATHEMATICAL THINKING

## Grades 3-5

**Mathematical thinking includes specific types of thinking that are unique to mathematics. These types of thinking connect content and competencies. In the field of mathematics education there are some broad types of thinking and reasoning that develop across the grades.**

### TYPES OF MATHEMATICAL THINKING

Problem-solving  
Additive thinking  
Algebraic thinking  
Multiplicative thinking  
Spatial reasoning  
Proportional reasoning  
Statistical thinking  
Functional reasoning

*In Grades 3-5, the focus is on developing problem-solving, algebraic thinking, spatial reasoning and multiplicative thinking.*

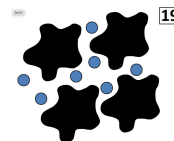
#### PROBLEM-SOLVING

Problem-solving is at the heart of what mathematics is. Problem-solving involves a process of understanding the problem, devising a plan (choose a strategy), carrying out the plan and looking back (analyze, reflect). This process was first described by George Polya in 1945 and still holds true today. Problem-solving also requires mathematical habits of mind and dispositions that include perseverance, taking risks and flexible thinking. With grades 3-5 students, math problems may be presented as a way to engage with mathematical content and competencies. Problems can be open problems with multiple answers or many ways of approaching the problem. Word or story problems using all four operations are presented to students and also created by students. Support students' problem-solving thinking by asking questions such as: *What do you know about this problem? What strategy could you try? Is there a different way you could solve this problem? How do you know this solution makes sense?*



#### ALGEBRAIC THINKING

Algebraic thinking is comprised of recognizing patterns, identifying relationships, making generalizations and analyzing change. With grades 3-5 students we investigate the relationships in increasing/decreasing patterns with concrete materials, visuals and numbers and begin to record these relationships in charts and tables. We also identify the "missing part" or change in addition, subtraction, multiplication and division equations. The instructional routine Splat! supports students' development of algebraic thinking.



#### MULTIPLICATIVE THINKING

Multiplicative thinking develops from an understanding of number relationships using arrays and areas models and decomposing into parts. Multiplicative thinking involves flexible strategies such as decomposing, doubling and halving and multiplying by 10s, 100s, etc. Grades 3-5 students develop reasoning to use numbers for multiplication and division in different ways focusing on the commutative and distributive properties. Students begin to understand magnitude, for example, what it means to be 100 times greater and this connects to understanding of place value.



#### SPATIAL REASONING

Spatial reasoning is a growing area of importance in mathematics as it is directly linked to overall school success. Spatial reasoning is embedded in many areas of mathematics learning and involves dynamic processes that often involve mental imagery and visualization as we think about shape and size in space, position, perspective, and the transformations of shapes. Grades 3-5 students develop spatial reasoning through tasks with materials such as blocks, pattern blocks, geoboards, and tangrams, doing puzzles, origami, coding, and playing games such as checkers, chess and board games.

