

# The Number Line, SRA Number Worlds, and Common Core State Standards



## Summary

The number line is a tool used in elementary, middle, and high school classrooms. Recent research suggests the importance of the number line as a tool for helping children develop greater flexibility in mental arithmetic as they actively construct mathematical meaning, number sense, and understandings of number relationships (Frykholm, 2010, p. 5). Furthermore, research shows the effectiveness of this manipulative when it is used to teach conceptual knowledge of number (Griffin, 2014, p. 5).

## The Number Line and Common Core State Standards

The number line is featured prominently in the Common Core State Standards, or CCSS. It serves as a visual /physical model to represent the counting numbers, an effective tool to develop estimation techniques, and a helpful instrument for solving problems (CaCCSS-M, 2010). The number line is a unifying representation for different sets of numbers that builds operations in a coherent mathematical way and presents fractions as numbers. Instruction with the number line fosters the use of the metric system and the decimal numbers, facilitates the discovery of the density property of rational numbers, and provides an opportunity to consider numbers that are not fractions as well as consider the existence of irrational numbers (LACOE, 2011).

Use of the number line persists not only across grade levels but also across domains (CaCCSS-M, 2010). In the Common Core State Standards, the number line is first explicitly addressed in a Grade 2 Measurement and Data standard involving the representation of whole numbers as lengths and whole-number sums and differences within 100 (LACOE, 2011; CCSSI, 2012). In addition, the number line is used to understand a fraction as a number in Grade 3 standards, represent fractions on a number line diagram to represent measurement quantities in Grade 4 standards, and to define a coordinate system using a pair of perpendicular lines in Grade 5 standards (CCSSI, 2012).

Number line references continue in middle school standards, as well as in high school statistics and probability standards (NCDPI, 2010, p.2). In Grade 6, the number line is used to define absolute value of a rational number as its distance from 0 on the number line. In Grade 7, the number line is used to represent the addition and subtraction of rational numbers. In addition, it is used to compare the size of irrational numbers and to estimate the value of expressions in Grade 8. In the High School Statistics and Probability domain, the number line is used to represent data with dot plots, histograms, and box plots (CCSSI, 2012).

## The Number Line and Common Core State Standards

SRA Number Worlds provides a rich set of activities that expose students to five different forms of number representation that are common in our culture, including position on a path or line in Line Land and position on a vertical scale in Sky Land (Griffin, 2004, p. 4).

Line Land addresses position on a line in which numbers come to represent a sequence of steps along an ordered path, not just the names that are assigned to set sizes of different magnitude (Griffin, 2004; Griffin, 2008). Perhaps the most important transition that children must make is to treat the physical addition or subtraction of objects as equivalent to the movement forward or backward along a line (Griffin, 2008). As students transition from concrete representations to conceptual understanding, they should be able to answer questions such as the ones listed below (Gordon, 2009).

- Where are you now?
- How far did you go?
- Who is farther or less far along the line?
- Do you go forward or backward?

In Sky Land, children learn about movement along a vertical rather than a horizontal plane, during which they learn to use the language of height (Griffin, 2004, 2008). Movement along a vertical scale is key to reading a thermometer or creating and interpreting a bar graph (Gordon, 2009). As students learn about moving along a vertical scale, they should be able to answer questions such as the ones listed below (Gordon, 2009).

- How high or low are you now?
- What number or amount is higher or lower?

Prevention Levels A–C employ horizontal and vertical number lines across the Common Core domains of Counting and Cardinality, and Operations and Algebraic Thinking, including the following topics (NWIG, 2015).

- Introduction to the Number Line
- Position on the Number Line
- Sequence on the Number Line
- Moving Up and Down
- Numbers on a Vertical Scale
- Numbers on a Line
- Adding and Subtracting on a Line
- Comparing Positions on a Line
- Moving on a Vertical Scale
- Number Sequence and Number Lines

In Intervention Levels D–J (Grades 2–8), number lines are used in lessons encompassing five Common Core domains (NWIG, 2015).

- Numbers on a Line
- Linear Measurement
- Measurement Tools
- Coordinate Grids
- Comparing Fractions
- Using Ratios and Rates
- Integers
- Using Integers
- Inequalities
- Showing Data in Line Plots
- Data Displays
- Measures of Center
- Adding and Subtracting Integers
- Properties of Addition and Subtraction

## The Importance of Engagement and Communication

Mathematically proficient students use language, symbols, tools, and diagrams to explain solutions, justify conclusions, engage in higher-order thinking, and deepen mathematical understanding. SRA Number Worlds provides students with daily opportunities to employ the Common Core State Standards for Mathematical Practice. Students participate in activities that use communication, logic, reasoning, modeling, tools, precision, structure, and patterns to make sense of and solve math problems (NWIG, 2015, p. 4). Therefore, students are routinely engaged in activities that foster the exploration, discussion, and application of mathematical concepts in real-world contexts (Griffin, 2004).

A carefully graded sequence of activities enables students to deepen current understandings and use these to construct new understandings. A seamless sequence of activities permits individual students to start at an appropriate individual level and to move through the normal developmental progression at a suitable pace (Griffin, 2004, p. 5). For example, number lines are used in a variety of forms to represent real-world contexts to help students. Younger students initially work with horizontal number lines that represent neighborhoods and progress to vertical number lines that depict bar graphs, elevators in a building, and thermometers. Middle school students use magnetized number lines as tools to explore and discuss rational numbers (Griffin 2014, p. 5).

Research indicates that students who are engaged in learning will be more successful. Instead of a predictable pattern of activity in math class that revolves around studying a modeled example and practicing that model, SRA Number Worlds offers a variety of instructional techniques that are appropriate for the concepts being taught and appeal to a variety of learners, including hands-on activities, games, guided discussions, response activities, and writing prompts (NWIG, 2015, p. 26).

The Teacher Edition and Instructional Activity Cards suggest alternative groupings that support oral communication and provide discussion questions that promote higher-order thinking. The Reflect prompts in the Student Workbook provide students with an opportunity to communicate mathematical ideas in writing and challenge them to gain deeper understanding of lesson concepts (NWIG, 2015, p. 27).

Through project-based learning activities, students develop a deeper understanding of key mathematical concepts by thinking about topics in real-world contexts and communicating these thoughts with their peers. The communication of ideas through discussion within the classroom is a powerful tool for ensuring student mastery of mathematics (NWIG, 2015, p.27).

Children who are familiar with various forms of representation and the language used to talk about numbers in the context of number lines, projects, and manipulatives have a much easier time making sense of the number problems they encounter inside and outside of school (Griffin, ECRQ, 2004, p.178).

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