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# Content and Timeline for Mathematics

## *Algebra I*



West Virginia DEPARTMENT OF  
EDUCATION



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## Algebra I

The West Virginia College- and Career-Readiness Standards for mathematics emphasize key content, skills, and mathematical habits of mind at each grade level. The focus of instruction is placed on course standards; instruction should integrate content standards and mathematical habits of mind. Instruction should be attentive to learning across course domains and link major topics within domains. Instruction should develop conceptual understanding, procedural skill and fluency, and application.

Students in Algebra I will focus on five critical units that deepen and extend understanding of linear and exponential relationships by contrasting them with each other and by applying linear models to data that exhibit a linear trend, and students engage in methods for analyzing, solving, and using quadratic functions.

The following table highlights the content at the cluster level for Algebra I standards. The bulk of instructional time should be given to the clusters and the standards within them. Standards should not be neglected; to do so would result in gaps in students' learning, including skills and understandings they may need in later grades. Instruction should reinforce standards within the clusters by including problems and activities that support natural connections between clusters. **Teachers and administrators alike should note that the standards are not topics to be checked off after being covered in isolated units of instruction;** rather, they provide content to be developed throughout the school year through rich instructional experiences presented in a coherent manner.

### Connections in the Traditional Pathway

Having already extended arithmetic from whole numbers to fractions (grades four through six) and from fractions to rational numbers (grade seven), students in grade eight encountered specific irrational numbers such as  $\sqrt{5}$  and  $\pi$ . In Algebra I, students now begin to understand the real number system. Students in middle grades worked with measurement units, including units obtained by multiplying and dividing quantities. In Algebra I, students apply these skills in a more sophisticated fashion to solve problems in which reasoning about units adds insight.

Algebraic themes beginning in middle school continue and deepen during high school. As early as grades six and seven, students began to use the properties of operations to generate equivalent expressions. By grade seven, they began to recognize that rewriting expressions in different forms could be useful in problem solving. In Algebra I, these aspects of algebra carry forward as students continue to use properties of operations to rewrite expressions, gaining fluency and engaging in what has been called “mindful manipulation.”



Students in grade eight extended their prior understanding of proportional relationships to begin working with functions, with an emphasis on linear functions. In Algebra I, students master linear and quadratic functions. Students encounter other kinds of functions to ensure that general principles of working with functions are perceived as applying to all functions, as well as to enrich the range of quantitative relationships considered in problems. Students in grade eight connected their knowledge about proportional relationships, lines, and linear equations. In Algebra I, students solidify their understanding of the analytic geometry of lines. They understand that in the Cartesian coordinate plane: the graph of any linear equation in two variables is a line; and any line is the graph of a linear equation in two variables.

As students acquire mathematical tools from their study of algebra and functions, they apply these tools in statistical contexts. In a modeling context, they might informally fit a quadratic function to a set of data, graphing the data and the model function on the same coordinate axes. They also draw on skills first learned in middle school to apply basic statistics and simple probability in a modeling context. For example, they might estimate a measure of center or variation and use it as an input for a rough calculation. Algebra I techniques open an extensive variety of solvable word problems that were previously inaccessible or very complex for students in kindergarten through grade eight. This expands problem solving dramatically.

In Algebra I, students use reasoning about structure to define and make sense of rational exponents and explore the algebraic structure of the rational and real number systems. They understand that numbers in real-world applications often have units attached to them—that is, the numbers are considered *quantities*. Students' work with numbers and operations throughout elementary and middle school has led them to an understanding of the structure of the number system; in Algebra I, students explore the structure of algebraic expressions and polynomials. They see that certain properties must persist when they work with expressions that are meant to represent numbers—which they now write in an abstract form involving variables. When two expressions with overlapping domains are set as equal to each other, resulting in an equation, there is an implied solution set (be it empty or non-empty), and students not only refine their techniques for solving equations and finding the solution set, but they can clearly explain the algebraic steps they used to do so.

Students began their exploration of linear equations in middle school, first by connecting proportional equations ( $y = kx$ ,  $k \neq 0$ ) to graphs, tables, and real-world contexts, and then moving toward an understanding of general linear equations ( $y = mx + b$ ,  $m \neq 0$ ) and their graphs. In Algebra I, students extend this knowledge to work with absolute value equations, linear inequalities, and systems of linear equations. After learning a more precise definition of *function* in this course, students examine this new



idea in the familiar context of linear equations—for example, by seeing the solution of a linear equation as solving  $f(x) = g(x)$  for two linear functions  $f$  and  $g$ .

Students continue to build their understanding of functions beyond linear ones by investigating tables, graphs, and equations that build on previous understandings of numbers and expressions. They make connections between different representations of the same function. They also learn to build functions in a modeling context and solve problems related to the resulting functions. Note that in Algebra I the focus is on linear, simple exponential, and quadratic equations.

Finally, students extend their prior experiences with data, using more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, students look at residuals to analyze the goodness of fit.

Algebra I	West Virginia College- and Career-Readiness Standards
<b>Relationships between Quantities and Reasoning with Equations</b>	
<p><b>Clusters</b></p> <ul style="list-style-type: none"> <li>• Reason quantitatively and use units to solve problems.</li> <li>• Interpret the structure of expressions.</li> <li>• Create equations that describe numbers or relationships.</li> <li>• Understand solving equations as a process of reasoning and explain the reasoning.</li> <li>• Solve equations and inequalities in one variable.</li> </ul>	<ul style="list-style-type: none"> <li>• M.A1HS.1-3</li> <li>• M.A1HS.4</li> <li>• M.A1HS.5-8</li> <li>• M.A1HS.9</li>   <li>• M.A1HS.10</li> </ul>
<b>Linear and Exponential Relationships</b>	
<p><b>Clusters</b></p> <ul style="list-style-type: none"> <li>• Extend the properties of exponents to rational exponents.</li> <li>• Solve systems of equations.</li> <li>• Represent and solve equations and inequalities graphically.</li> <li>• Understand the concept of a function and use function notation.</li> <li>• Interpret functions that arise in applications in terms of a context.</li> </ul>	<ul style="list-style-type: none"> <li>• M.A1HS.11-12</li> <li>• M.A1HS.13-14</li> <li>• M.A1HS.15-17</li> <li>• M.A1HS.18-20</li> <li>• M.A1HS.21-23</li> </ul>



<ul style="list-style-type: none"> <li>Analyze functions using different representations.</li> <li>Build a function that models a relationship between two quantities.</li> <li>Build new functions from existing functions.</li> <li>Construct and compare linear, quadratic, and exponential models and solve problems.</li> <li>Interpret expressions for functions in terms of the situation they model.</li> </ul>	<ul style="list-style-type: none"> <li>M.A1HS.24-25</li> <li>M.A1HS.26-27</li> <li>M.A1HS.28</li> <li>M.A1HS.29-31</li> <li>M.A1HS.32</li> </ul>
<b>Descriptive Statistics</b>	
<p><b>Clusters</b></p> <ul style="list-style-type: none"> <li>Summarize, represent, and interpret data on a single count or measurement variable.</li> <li>Summarize, represent, and interpret data on two categorical and quantitative variables.</li> <li>Interpret linear models.</li> </ul>	<ul style="list-style-type: none"> <li>M.A1HS.33-35</li> <li>M.A1HS.36-37</li> <li>M.A1HS.38-40</li> </ul>
<b>Expressions and Equations</b>	
<p><b>Clusters</b></p> <ul style="list-style-type: none"> <li>Interpret the structure of equations.</li> <li>Write expressions in equivalent forms to solve problems.</li> <li>Perform arithmetic operations on polynomials.</li> <li>Create equations that describe numbers or relationships.</li> <li>Solve equations and inequalities in one variable.</li> <li>Solve systems of equations.</li> </ul>	<ul style="list-style-type: none"> <li>M.A1HS.41-42</li> <li>M.A1HS.43</li> <li>M.A1HS.44</li> <li>M.A1HS.45-47</li> <li>M.A1HS.48</li> <li>M.A1HS.49</li> </ul>
<b>Quadratic Functions and Modeling</b>	
<p><b>Clusters</b></p> <ul style="list-style-type: none"> <li>Use properties of rational and irrational numbers.</li> <li>Interpret functions that arise in applications in terms of a context.</li> <li>Analyze functions using different representations.</li> </ul>	<ul style="list-style-type: none"> <li>M.A1HS.50</li> <li>M.A1HS.51-53</li> <li>M.A1HS.54-56</li> </ul>



- Build a function that models a relationship between two quantities.
- Build new functions from existing functions.
- Construct and compare linear, quadratic and exponential models and solve problems.

- M.A1HS.57
- M.A1HS.58-59
- M.A1HS.60

### Explanations

- Domains are broad components that make up a content area. Domains in mathematics vary by grade-level and by course. For example, the five domains for mathematics of Algebra I are Relationships between Quantities and Reasoning with Equations; Linear and Exponential Relationships; Descriptive Statistics; Expressions and Equations; and Quadratic Functions and Modeling.
- **Clusters** are groups of standards that define the expectations students must demonstrate to be college- and career-ready.
- **Standards** are expectations for what students should know, understand and be able to do; standards represent educational goals.

*Note of caution: Neglecting material will leave gaps in students' skills and understandings and will leave students unprepared for the challenges they face in later grades.*



## Algebra I Content Plan

Teachers must provide students the opportunity to master each of the course content standards. **It is important to understand that neglecting grade-level content standards will leave gaps in students' skills and understandings and will leave students unprepared for the challenges they face in this and later courses.** Any content plan must demonstrate a means by which students can be provided the opportunity to address all grade-level content standards and to revisit and practice skills and strengthen understandings throughout the school year. The information below is an example of how to address all Algebra I standards in a school year.

DOMAIN TOPIC	Linear and Exponential Relationships	Linear and Exponential Relationships	Linear and Exponential Relationships	Relationships between Quantities and Reasoning with Equations	Relationships between Quantities and Reasoning with Equations	Quadratic Functions and Modeling	Expressions and Equations	Quadratic Functions and Modeling	Descriptive Statistics
	<i>Sequences</i>	<i>Linear and Exponential Functions</i>	<i>Features of Functions</i>	<i>Equations and Inequalities</i>	<i>Systems of Equations and Inequalities</i>	<i>Quadratic Functions</i>	<i>Structure of Expressions</i>	<i>More Functions, More Features</i>	<i>Modeling Data</i>
SAMPLE TIMELINE	August/September	September/October	November	November/December	January	February/March	March/April	April/May	May/June
CONTENT STANDARDS	M.A1HS.2 M.A1HS.4 M.A1HS.10 M.A1HS.26 M.A1HS.27 M.A1HS.28 M.A1HS.29 M.A1HS.30 M.A1HS.32	M.A1HS.11 M.A1HS.12 M.A1HS.15 M.A1HS.20 M.A1HS.24 M.A1HS.26 M.A1HS.27 M.A1HS.28 M.A1HS.29 M.A1HS.30 M.A1HS.31 M.A1HS.32 M.A1HS.37 M.A1HS.41 M.A1HS.43 M.A1HS.46 M.A1HS.55	M.A1HS.7 M.A1HS.16 M.A1HS.17 M.A1HS.18 M.A1HS.19 M.A1HS.20 M.A1HS.21 M.A1HS.22 M.A1HS.23 M.A1HS.24 M.A1HS.25 M.A1HS.26 M.A1HS.27 M.A1HS.28	M.A1HS.1 M.A1HS.2 M.A1HS.3 M.A1HS.9 M.A1HS.10 M.A1HS.47	M.A1HS.6 M.A1HS.7 M.A1HS.8 M.A1HS.13 M.A1HS.14 M.A1HS.17 M.A1HS.44 M.A1HS.46 M.A1HS.47	M.A1HS.4 M.A1HS.6 M.A1HS.21 M.A1HS.26 M.A1HS.29 M.A1HS.30 M.A1HS.31 M.A1HS.46 M.A1HS.60	M.A1HS.5 M.A1HS.8 M.A1HS.24 M.A1HS.26 M.A1HS.28 M.A1HS.42 M.A1HS.43 M.A1HS.44 M.A1HS.45 M.A1HS.47 M.A1HS.48 M.A1HS.55	M.A1HS.21 M.A1HS.22 M.A1HS.23 M.A1HS.32 M.A1HS.49 M.A1HS.50 M.A1HS.51 M.A1HS.52 M.A1HS.53 M.A1HS.54 M.A1HS.55 M.A1HS.56 M.A1HS.57 M.A1HS.58 M.A1HS.59	M.A1HS.33 M.A1HS.34 M.A1HS.35 M.A1HS.36 M.A1HS.37 M.A1HS.38 M.A1HS.39 M.A1HS.40
RATIONALE	In the sample above, Algebra I begins with students reasoning about sequences and expanding this perception to develop an understanding of functions and their features. Applications of functions create the need to expand problem-solving skills in equations, inequalities, and systems of equations and inequalities. Students strengthen their ability in procedural fluency, conceptual understanding, and applications.								







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