

Archdiocese of Chicago: Mathematics Curriculum Framework

Grade 9: Algebra 1 Focus

**State Goal 6:** Demonstrate and apply a knowledge and sense of numbers, including numeration and operations (addition, subtraction, multiplication, division), patterns, ratios, and proportions.

Learning Standard/Outcome	Sample Assessment	Connections
<p><b><i>Critical for Mastery at Grade 9:</i></b></p> <p>9.06.01 Represent, order, and compare real numbers. (6A)</p> <p>9.06.02 Compare and contrast the properties of numbers and number systems, including the rational and real numbers. (6B)</p> <p>9.06.03 Determine an appropriate numerical representation of a problem situation, including roots and powers, if applicable. (6B)</p> <p>9.06.04 Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities. (6B)</p> <p>9.06.05 Simplify expressions using the field properties, order of operations, and properties of equality for the set of real numbers. (6B)</p>	<p>Compare a list of real numbers using Venn Diagrams.</p> <p>Crte a graphic organizer to compare and contrast real numbers.</p> <p>The cost of living can be demonstrated through an exponential growth curve that follows the exponential growth equation: <math>y = C(1+r)^t</math>. If the initial hourly wage was \$2.60 and the cost of living increased was 6.0%, write the proper numerical representation for the cost of living.</p> <p>Given the equation, <math>(4x)^2 \cdot y = c</math>, students should determine the effect of doubling <math>y</math> on the magnitude of <math>c</math>, the effects of halving <math>x</math> on <math>c</math>, the effect of tripling <math>x</math> on <math>c</math>, etc.</p> <p>Simplify algebraic expressions in one variable.</p>	<p>Connect to social studies: Using a historical timeline, students will represent and order real numbers.</p> <p>Connect to speech and technology: Present the graphic organizer to the class using Power Point.</p> <p>Connect to life: Analyze the results of the cost of living growth curve. How would this affect the standard of living for a single person, a family, a college student?</p> <p>Connect to life: Double one side of a rectangular garden. How is the area affected?</p> <p>Connect to critical thinking: Solve problems where the student must add parentheses to make the expression true.</p>

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<p>9.06.06 Develop fluency in operations with real numbers using mental computation or paper-and-pencil calculations for simple cases and technology for more complicated cases. (6B, 6C)</p> <p>9.06.07 Determine and explain whether exact values or approximations are needed in a variety of situations. (6C)</p> <p>9.06.08 Develop an appropriate number of significant digits to represent an outcome. (6C)</p>	<p>Solve algebraic equations in one variable, powers, roots, or proportions.</p> <p>Given several scenarios the students should decide if approximations or exact values are needed; such as friends splitting the cost evenly for a restaurant bill when the amount to be paid by each cannot be evenly divided.</p> <p>Students should measure the length and width of the classroom. Some students should measure the room in feet, others in meters, and others in inches. The students should then calculate the area of the room and report the answer using the appropriate number of significant digits.</p>	<p>Connect to science: Solve velocity problems.</p> <p>Students should write their own scenarios where approximations and exact values are necessary.</p> <p>Connect to life: In Business, students are asked to solve money problems. If students are asked to solve a price per unit, they should decide the proper number of significant digits in the answer. Would it make sense to report a gain or loss of \$1.000435? Explain.</p>

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<p>9.06.09 Explain how ratios and proportions can be used to solve problems of percent, growth, and error tolerance. (6D)</p> <p>9.06.10 Set up and solve direct and inverse variation of simple quantities. (6D)</p> <p><i>Significant to Develop at Grade 9:</i></p> <p>9.06.11 Organize problem situations using matrices. (6A)</p> <p>9.06.12 Solve problems using simple matrix operations. (6B)</p>	<p>Students should research the growth curve for humans (ask the family doctor for the curve he/she uses). By comparing their growth while young, determine their ratio for growth. Predict how tall they will be when an adult.</p> <p>The weight that an airship is capable of supporting varies directly with its volume. The students should write the equation for the relationship. After researching airships, the students should solve the equation given either the volume or weight.</p> <p>Students should rewrite a table in matrix format.</p> <p>Students should solve matrix problems using addition and subtraction.</p>	<p>Students should look in the newspaper to find the exchange rates for currency. Use ratios and proportions to calculate the value of foreign currency obtained for \$100 U.S. dollars. Determine the percent difference among the different foreign currency.</p> <p>Connect to science: In chemistry the Gas Laws are examples of direct and inverse variations. Students should use the inverse relationship of Boyle's Law (<math>P_1V_1 = P_2V_2</math>), to calculate the change in volume of a gas when the other three values are known.</p> <p>Connect to technology: Make a spreadsheet for data taken from a newspaper article or a spreadsheet showing stock from a section of a store.</p>

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<p><i>Useful to Work On at Grade 9:</i></p> <p>9.06.13 Illustrate the relationship between second and third power roots and powers of a number. (6A)</p>	<p>Students should illustrate the relationship between the area of a square and the volume of a cube.</p>	<p>Connect to life: Determine the amount of airspace in the classroom and the amount of floor space. Do the same for other spaces. Discuss the relationships.</p>

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State Goal 7: Estimate, make and use measurements of objects, quantities and relationships and determine acceptable levels of accuracy.

Learning Standard/Outcome	Sample Assessment	Connections
<p><b><i>Critical for Mastery in Algebra I:</i></b></p> <p>9.07.01 Select units and scales that are appropriate for problem situations involving measurement. (7A)</p> <p>9.07.02 Check measurement computations using unit analysis. (7C)</p> <p>9.07.03 Solve problems involving multiple rates, measures, and conversions. (7C)</p>	<p>Demonstrate knowledge of measurable attributes and appropriate units and scales in the U.S. customary and metric systems for such measurements (e.g., linear units, square units, cubic units). Give examples of situations in which each type of measure would be appropriate.</p> <p>Solve and check computations involving measurements using unit analysis (At 55 mph, how many miles could someone travel in 6.5 hours?)</p> <p>Using the formula for simple interest, find the difference in the cost of financing a car at two different rates for three years or for five years.</p>	<p>Connect to science: Research and list measurements that are related to specific topics (e.g., power is measured in watts; energy is measured in joules). Connect to religion: The Bible uses an ancient measure, the “cubit”. Convert the dimensions of Noah’s ark from cubits to inches to feet.</p> <p>Connect to social studies/driver’s education: Using established data, compare the legal maximum speed limits in the fifty states. Make a line plot of the data.</p> <p>Connect to business/finance: Compare and contrast the change in interest rates over the past ten years as it affects a car loan.</p>

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Learning Standard/Outcome	Sample Assessment	Connections
<p><b><i>Significant to Develop in Algebra I:</i></b></p> <p>9.07.04 Convert between the U.S. customary and metric systems using the conversion factor. (7A)</p> <p>9.07.05 Solve problems using indirect measurement by choosing appropriate technology, instruments, and/or formulas. (7C)</p> <p><b><i>Useful to Develop in Algebra I:</i></b></p> <p>9.07.06 Determine answers to an appropriate degree of accuracy using significant digits. (7B)</p>	<p>Using established conversion factors (e.g., to change miles to kilometers, multiply by 1.6093), write and solve problems such as, “The distance from City A to City B is 563 miles. Convert this to kilometers and round to the nearest tenth, if necessary.”</p> <p>Use the Pythagorean theorem to calculate the measure of the third side of a right triangle, given the measures of the other two sides. Depending on the complexity of the measures, demonstrate the key sequence on a calculator.</p> <p>Using the guidelines for determining the number of significant digits in each addend of a problem, find the sum and round it to the appropriate number of significant digits.</p>	<p>Connect to social studies and science; Research the <i>Le Systeme Internaionale (SI)</i>, an improved version of the metric system derived circa 1960, and explain how to convert an astronomical unit (AU) from meters to kilometers.</p> <p>Connect to architecture: Find examples of how and why triangles are frequently used in building design and construction. Research the use of the golden ratio in art.</p>

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Grade 9 – Algebra Focus

State Goal 8: Use algebraic and analytical methods to identify and describe patterns and relationships in data, solve problems and predict results.

Learning Standard/Outcome	Sample Assessment	Connections
<p><b><i>Critical for Mastery at Grade 9:</i></b></p> <p>9.08.01 Represent and explain mathematical relationships using symbolic algebra. (8A)</p> <p>9.08.02 Create and connect representations of data through tables, graphs, numbers, and algebra and make a line of best fit using technology. (8B)</p> <p>9.08.03 Approximate and interpret rates of change from graphical and numerical data and identify a constant rate of change as the slope of a linear relationship. (8A)</p>	<p>With a partner, have students make-up real life scenarios involving variable expressions, for example: “eight apples more than twice the number of apples that Anna has,” exchange with each other and write the variable expression and check with partner sharing in a discussion.</p> <p>After completing a class survey. (For example, survey the class on the number of CDs they own or the distance they live from school). Students make a table of their data, graph the data and determine the line of best fit that matches the data using a graphics calculator.</p> <p>Gather sets of data and graphs that relate to real life scenarios from the internet, for example, weather patterns or college entrance exams. Have students work in groups to identify the rates of change and to determine if any are consistent and therefore represent a linear relationship.</p>	<p>Relate this to other real world situations in which symbols are used to represent something. (For example, street signs, octagon represents stop sign)</p> <p>Relate this to graphs and charts that are found in the newspaper and explain the application.</p>

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<p>9.08.04 Identify slope in an equation and from a table of values. (8B)</p> <p>9.08.05 Describe the relationships of the independent and dependent variables from a graph. (8B)</p> <p>9.08.06 Recognize and describe the general shape and properties of the graphs of linear, absolute value, and quadratic functions from equations, graphs, or sets of ordered pairs and data. (8B)</p> <p>9.08.07 Simplify algebraic expressions using a variety of methods, including factoring. (8A)</p>	<p>Students are given a number of different linear functions. They find the slope of the linear function when it is in standard form, point-slope form or slope-intercept form.</p> <p>Give students graphs that compare different types of data and have them sort out “what depends on what.” Then have students share with the class.</p> <p>Give a group of students different sets of data tables, have them plot the points in a coordinate plane, name the type of graph they see and have them match this graph to a type of equation.</p> <p>Students will work in teams to simplify practice problems on a classroom set of dry erase boards.</p>	<p>Look at the weather channel or weather report in the newspaper and determine if certain information given depends on specific situations. Is there a linear relationship that connects the data?</p> <p>Relate to a discussion of social inequalities and how could these problems be solved.</p>

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<p>9.08.08 Write and solve equivalent forms of linear equations, simple quadratic equations, inequalities, and systems of equations with fluency. (8D)</p> <p>9.08.09 Solve problems of direct variation situations using a variety of methods. (8D)</p> <p>9.08.10 Interpolate and extrapolate to solve problems using systems of numbers. (8C)</p>	<p>Students set up equations and solve story problems that relate real life situations to linear equations (like an hourly salary problem), quadratic equations (like the area of a garden problem), inequalities, (like a comparison of income of two different jobs) or systems of equations (like cost of soda and fries versus quantity).</p> <p>Students design real-life scenarios that model situations of direct variation (for example: distance increases as speed increases). Have them solve each others problems.</p> <p>Have students make a booklet that shows how to solve the same system of equations in all the different methods. Students must explain each method and describe its pros and cons based on the given system.</p>	<p>Relate this to other forms of journalism in which writers discuss the pros and cons of different topics of interest.</p> <p>Take a road trip and include different parameters as they relate to direct variation.</p> <p>Relate this to a situation in which two or more lawyers are presenting their cases and the judge or jury is weighing what is presented.</p>

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<p>9.08.11 Solve simple problems involving quadratic relationships using technology for graphing. (8D)</p> <p><i>Significant to Develop at Grade 9:</i></p> <p>9.08.12 Graph absolute values of linear functions on the Cartesian plane. (8B)</p> <p>9.08.13 Describe and compare the properties of linear and quadratic functions. (8C)</p>	<p>Students use the graphics calculator to draw a picture of the quadratic relationship. They interpret the picture to solve their problem. For example, to solve, <math>x^2 - 1 = 3</math> the students would draw a picture of the function. They would then find where the curve matched up with 3 on the y-axis and match the corresponding x value.</p> <p>Give students an absolute value function and have them graph it on a coordinate plane. Have them check their answer with a graphic display calculator.</p> <p>Have some students present all properties and characteristics of linear functions while other students present the same about quadratic functions. Lead a group discussion that compares and contrasts these properties and characteristics.</p>	<p>Relate this to the real world in which adults become experts in one specific area and they rely on each other to accomplish many things.</p>

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<p>9.08.14 Create word problems that meet given conditions and represent simple power or exponential relationships, or direct or inverse variation situations. (8D)</p> <p><i>Useful to Work on at Grade 9:</i></p> <p>9.08.15 Interpret the role of the coefficients and constants on the graph of linear and quadratic functions given a set of equations. (8B)</p> <p>9.08.16 Relate the effect of translations and dilations on linear graphs and equations. (8B)</p>	<p>Students find examples of real life applications of exponential relationships (for example: interest problems) and direct or inverse variation relationships (for example: rate problems or pressure problems) and have students write their own word problems and share with each other.</p> <p>Students use a graphics calculator to graph linear and quadratic functions that have different coefficients and different constants and they make rules for the roles of these changed values.</p> <p>In groups have students (with the use of the graphics calculator) become experts on vertical translations, horizontal translations, vertical dilations, or horizontal dilations. Have each group teach their translation to the rest of the class.</p>	

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<p>9.08.17 Recognize direct variation, inverse variation, linear, and exponential curves from their graphs, a table of values, or equations. (8B)</p> <p>9.08.18 Solve problems by recognizing how an equation changes when parameters change. (8C)</p>	<p>Play a matching game. Given a group of different functions that represent direct variation, inverse variation, linear, or exponential relationships, students must match these to the table, graph or equations that would be the product of such a relationship.</p> <p>Students must successfully solve equations with varying sets of parameters.</p>	<p>Connect to media in the world. How often we use pictures to predict what has happened or to determine the solution to a problem.</p> <p>Have a discussion on how parameters may be defined.</p>

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State Goal 9: Use geometric methods to analyze, categorize and draw conclusions about points, lines, planes and space.

Learning Standard/Outcome	Sample Assessment	Connections
<p><b><i>Critical for Mastery at Grade 9:</i></b></p>		
<p>9.09.01 Calculate distance, midpoint coordinates, and slope using coordinate geometry. (9A)</p>	<p>Given the coordinates of two points, determine distance between the points using the distance formula. Using midpoint formula find the midpoint. Calculate the slope between the midpoint and the two given points.</p>	<p>Overlay a geographical map with a grid and find the distance between two towns using the distance formula.</p>
<p>9.09.02 Solve pictorial or word problems that involve geometric relationships within a single geometric shape or figure, including the Pythagorean theorem. (9A)</p>	<p>Given the length and width as variable expressions and the area as an integer, find the dimensions of the rectangle.</p>	<p>Connect to art/design class: Plan the proper size for a drawing and the surrounding frame.</p>
<p>9.09.03 Analyze geometric situations using Cartesian coordinates. (9A)</p>	<p>Determine whether two lines are parallel, perpendicular or neither using the slope formula.</p>	
<p>9.09.04 Represent, solve, and explain numerical and algebraic relationships using geometric concepts. (9C)</p>	<p>Find the measure of an angle if the sum of the measures of its supplement and complement is <math>162^\circ</math>.</p>	
<p>9.09.05 Solve problems involving similar figures (9B)</p>	<p>Write a proportion using similar triangles and solve for an unknown side.</p>	<p>Connect to art: Draw a picture of a shadow cast by a tree and a person walking away from tree and also casting a shadow.</p>

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State Goal 10: **Collect, organize and analyze data using statistical methods; predict results; and interpret uncertainty using concepts of probability.**

Learning Standard/Outcome	Sample Assessment	Connections
<p><i><b>Critical for Mastery at Grade</b></i></p> <p>09.10.01 Construct, read, interpret, infer, predict, draw conclusions, and evaluate data from various displays, including histograms and scatter plots. (10A)</p> <p>09.10.02 Analyze graphical displays of data for possible misleading characteristics. (10A)</p> <p>09.10.03 Determine the best measure of central tendency from mean, median, or mode. (10A)</p>	<p>Obtain a set of test scores for a class. Display the scores by creating a list, a stem and leaf plot, a scatterplot, and a box plot.</p> <p>Have each student bring in a data display from a magazine or book. Analyze the data and make predictions. Look at the graphs for errors in scale, display or interpretation.</p> <p>Use ACT scores from the last few years to find mean, median, mode, and standard deviation. Compare and contrast and try to draw some conclusions.</p>	<p>Look at the school's budget and determine how to represent the information to show what portion of the budget is used for instruction.</p> <p>What do the figures tell about the increase of Catholics in the US?</p> <p>How do we ethically represent data?</p> <p>How is data displayed to influence decision making?</p>



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<p><i>Significant to Develop at Grade</i></p> <p>09.10.06 Describe and explain complementary and mutually exclusive events using appropriate terminology.</p> <p>09.10.07 Discuss the difference in empirical and theoretical probability. (10C)</p> <p>09.10.08 Compute probabilities for simple compound events using a variety of methods, including area models. (10C)</p> <p>09.10.09 Identify situations where dependent and independent events occur. (10C)</p>	<p>Collect data on the height of the male adults in the school. What can you determine from this information?</p> <p>Have a bag of different colored socks. Talk about the probability of drawing two socks of the same color in two consecutive draws with and without replacement of the sock.</p> <p>Flip a coin 12 times, do you have exactly 6 heads and 6 tails each round. Why?</p> <p>Obtain a bag of 6 marbles of different colors and have a set of two or more dice, develop the sample set for all the possible outcomes and then determine given probabilities.</p> <p>Classify the assigning of schedules to students as dependent or independent</p>	<p>Create a schedule for a job.</p>

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<p>09.10.10 Make conjectures about the possible correlation between two characteristics of a sample on the basis of scatter plots of the data and approximate lines of fit. (10A)</p> <p><b>Useful to work on at grade</b></p> <p>09.10.11 Discuss how data can be manipulated to represent different points of view based on the use of different measures of central tendency and based on different graphical displays. (10A)</p> <p>09.10.12 Discuss biased reporting of data and questions that should be asked when data is viewed. (10A)</p>	<p>Gather data on the number of hours of sleep that a student gets per night and the student’s score on a chapter test. Is there any correlation?</p> <p>Bring in several examples of the same data set displayed in several different ways. Which display is the truest to the data display?</p> <p>Look at the “Numbers” column in Time magazine. Is the data biased? How was it collected?</p>	