



SAMPLE MATERIAL

## Mathematics Essential Learnings

Castle View High School, Colorado

Legend High School, Colorado

**Topic:** National Math Panel: Major Topics of School Algebra

**Practice:** Topics of Algebra

District math supervisor Larry Linnen convened mathematics teachers in Douglas County School District (including teachers at Castle View and Legend High Schools) to develop essential learnings in an attempt to focus instruction on the most important topics and skills in mathematics. This excerpt from the district's essential learning document details the essential learnings for the secondary mathematics courses, including algebra. The essential learnings guide curricular choices as well as assessments.

## DCSD Mathematics Essential Learnings – February 2007

Pre-Algebra	Algebra I	Geometry
<p>It is expected that these essential learnings be addressed within contexts that promote problem solving, reasoning, communications (within and outside of mathematics), making connections, and designing and analyzing representations.</p> <ol style="list-style-type: none"> <li>1. <i>Develops an understanding of operations on rational numbers.</i> <ul style="list-style-type: none"> <li>• Uses order of operations (including exponents) to solve problems</li> <li>• Develops fluency with integers</li> <li>• Solves one- and two-step equations using rational numbers</li> <li>• Solves problems using Pythagorean Theorem with perfect squares</li> </ul> </li> <li>2. <i>Develops an understanding of patterns.</i> <ul style="list-style-type: none"> <li>• Represents, describes, and analyzes using tables, graphs, rules, and/or symbols</li> <li>• Analyzes, represents, and describes geometric and numeric patterns using standard algebraic notation.</li> </ul> </li> <li>3. <i>Develops an understanding of and uses descriptive statistics, including mean, median, mode, and range to summarize and compare data sets, and organize and display data to pose and answer questions.</i> <ul style="list-style-type: none"> <li>• Evaluates the effects that changing data values have on the measures of central tendency</li> <li>• Selects and justifies the appropriate measure of central tendency for a given situation</li> </ul> </li> </ol>	<p>It is expected that these essential learnings be addressed within contexts that promote problem solving, reasoning, communications, making connections (within and outside of mathematics), and designing and analyzing representations.</p> <ol style="list-style-type: none"> <li>1. <i>Analyzes and represents linear functions and solves linear equations and systems of linear equations.</i> <ul style="list-style-type: none"> <li>• Uses algebraic manipulation to solve problems</li> <li>• Interprets the meaning of slope and intercepts in the context of a given situation</li> <li>• Represents functional relationships using written explanations, situations, tables, equations, and graphs and describes the connections among these representations</li> <li>• Uses a variety of methods to solve systems, estimates reasonableness of solutions, models real world phenomena related to linear functions, and relates the solution to pairs of lines</li> </ul> </li> <li>2. <i>Analyzes and represents quadratic equations to solve problems.</i> <ul style="list-style-type: none"> <li>• Adds, subtracts, and multiplies basic polynomial expressions</li> <li>• Applies factoring techniques to quadratic expressions</li> <li>• Solves quadratics with rational solutions, estimates reasonableness of solutions, and models real world phenomena related to quadratic functions</li> </ul> </li> <li>3. <i>Evaluates and simplifies algebraic expressions.</i> <ul style="list-style-type: none"> <li>• Simplifies expressions with positive, negative, and zero exponents (including scientific notation)</li> <li>• Simplifies, adds, subtracts, multiplies, and divides square roots</li> <li>• Solves problems using Pythagorean Theorem,</li> </ul> </li> </ol>	<p>It is expected that these essential learnings be addressed within contexts that promote problem solving, reasoning, communications, making connections (within and outside of mathematics), and designing and analyzing representations.</p> <ol style="list-style-type: none"> <li>1. <i>Analyzes and applies concepts of plane geometry.</i> <ul style="list-style-type: none"> <li>• Applies concepts of right triangles including (Pythagorean theorem, including 30-60-90, 45-45-90; basic trigonometric functions: sine, cosine, tangent)</li> <li>• Identifies and applies similarity, congruence, and symmetry.</li> <li>• Describes, measures, and applies properties of polygons and circles</li> <li>• Classify and analyze angles and their relationships with parallel lines, transversals, and special angle pairs</li> </ul> </li> <li>2. <i>Analyzes and applies concepts of coordinate geometry.</i> <ul style="list-style-type: none"> <li>• Recognizes and uses translations and reflections to solve transformation questions.</li> <li>• Uses coordinate geometry to calculate distance, midpoint, and find equations of lines including parallel and perpendicular</li> </ul> </li> <li>3. <i>Describes, analyzes and applies properties of 3-dimensional geometry.</i> <ul style="list-style-type: none"> <li>• Calculates volume and surface area of right solids and volume of spheres</li> <li>• Applies three-dimensional geometry to answer situational questions and problems</li> </ul> </li> </ol>

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	<p>estimates reasonableness of solutions, and models real world phenomena related to the Pythagorean Theorem</p>	
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Algebra II	Course(s) to precede Calculus	Calculus
<p>It is expected that these essential learnings be addressed within contexts that promote problem solving, reasoning, communications, making connections (within and outside of mathematics), and designing and analyzing representations.</p> <ol style="list-style-type: none"> <li>1. <i>Graphs (basic / parent) functions and applies concepts to linear, quadratic, absolute value, and radical functions, manually and incorporating technology.</i> <ul style="list-style-type: none"> <li>• Model real-world phenomena using linear and quadratic equations</li> <li>• Model real-world phenomena using absolute value and radical functions</li> </ul> </li> <li>2. <i>Solves equations, inequalities and systems using a method appropriate to the problem situation.</i> <ul style="list-style-type: none"> <li>• Graphing</li> <li>• Factoring</li> <li>• Quadratic Formula</li> <li>• Completing the square</li> <li>• Graphing calculator</li> </ul> </li> <li>3. <i>Performs translations and reflections of linear, quadratic and absolute value functions.</i> <ul style="list-style-type: none"> <li>• Performs reflections and rotations analytically or on a Cartesian coordinate system by applying algorithms</li> <li>• Uses equations to determine the horizontal and vertical shifts as well as non-rigid transformations</li> </ul> </li> <li>4. <i>Simplifies rational, exponential, and radical expressions.</i> <ul style="list-style-type: none"> <li>• Rational Expressions</li> <li>• Exponential Expressions</li> <li>• Radical Expressions</li> </ul> </li> </ol>	<p>It is expected that these essential learnings be addressed within contexts that promote problem solving, reasoning, communications, making connections (within and outside of mathematics), and designing and analyzing representations.</p> <ol style="list-style-type: none"> <li>1. <i>Uses and applies trigonometry.</i> <ul style="list-style-type: none"> <li>• Finds exact trigonometric values for special reference angles using degrees and radians</li> <li>• Graphs the six trigonometric functions with transformations</li> <li>• Solves equations</li> <li>• Calculates inverses</li> <li>• Recognizes and uses identities</li> </ul> </li> <li>2. <i>Analyzes, graphs, and solves polynomial, rational, exponential, and logarithmic functions.</i> <ul style="list-style-type: none"> <li>• Polynomial functions</li> <li>• Exponential functions</li> <li>• Logarithmic functions</li> </ul> </li> <li>3. <i>Identifies characteristics of functions.</i> <ul style="list-style-type: none"> <li>• Domain and range</li> <li>• Discontinuities</li> <li>• End behavior</li> <li>• Zeros / intercepts</li> <li>• Inverses</li> <li>• Increasing / decreasing</li> <li>• Odd / even</li> <li>• One to one</li> </ul> </li> <li>4. <i>Finds composition of functions.</i> <ul style="list-style-type: none"> <li>• Substitutes entire function into another function</li> <li>• Simplifies composition of two functions</li> <li>• Finds and compares <math>(f \circ g)(x)</math> and <math>(g \circ f)(x)</math></li> <li>• Uses function composition to describe real-world situations</li> </ul> </li> <li>5. <i>Uses and applies concepts of conics.</i></li> </ol>	<p>It is expected that the calculus, as defined by the College Board, be addressed within contexts that promote problem solving, reasoning, communications, making connections (within and outside of mathematics), and designing and analyzing representations.</p> <ol style="list-style-type: none"> <li>1. <i>Reference College Board Advanced Placement Syllabus</i> <ul style="list-style-type: none"> <li>• Functions, Graphs, and Limits</li> <li>• Derivatives</li> <li>• Integrals</li> <li>• Polynomial Approximations and Series (Calculus BC)</li> </ul> </li> </ol>

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	<ul style="list-style-type: none"> <li>• Identifies characteristics</li> <li>• Graphs</li> <li>• Solves systems</li> </ul> <p>6. <i>Solves systems using matrices using a graphing calculator.</i></p> <ul style="list-style-type: none"> <li>• Put a system of equations into a graphing calculator to find the solution to the system</li> </ul> <p>7. <i>Performs regression analyses using a graphing calculator.</i></p> <ul style="list-style-type: none"> <li>• Uses a graphing calculator to determine the symbolic relationships, or equations, which best describe a set of numerical data</li> </ul>	
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