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A Comparison of the Common Core State Standards (CCSS) for Mathematics (June 2, 2010) to the American Diploma Project (ADP) Benchmarks for Mathematics (2004)

The purpose of this side-by-side comparison is to provide information to the states regarding the alignment of the *Common Core State Standards (CCSS) for Mathematics (June 2010)* to the *American Diploma Project (ADP) Benchmarks for Mathematics (2004)*. We hope this comparison proves helpful as the states begin their processes for adoption and implementation.

Findings: The Common Core State Standards are as rigorous as the American Diploma Project Benchmarks.

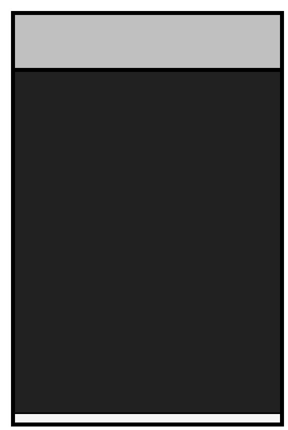
When the CCSS are compared to the ADP Benchmarks in mathematics, there is excellent alignment. All but one of the ADP Benchmarks are matched by one or more of the CCSS. The high school CCSS as well as some CCSS at a grade level below high school align with the ADP Benchmarks, which is appropriate given the differences between the purposes of the two documents. The ADP Benchmarks were developed to describe end-of-high-school expectations for college and career readiness, while the CCSS specify K-8 grade-level expectations along with the 9-12 grade span leading to college and career readiness. Some of the high school CCSS are also aligned with the ADP Benchmarks that are recommended for students intending to pursue mathematics-intensive careers or courses of study. The additional mathematics that students should learn in order to take advanced courses such as calculus, advanced statistics, or discrete mathematics is indicated by the symbol (+). Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (*). Details on specific alignments and commentary can be found within the side-by-side chart that follows.

Overlap Between the CCSS and ADP

CCSS (June 2010) with no counterpart in the ADP Benchmarks:

Overlap of the CCSS and the ADP Benchmarks:

ADP Benchmarks with no counterpart in the CCSS:



These CCSS describe in greater detail, build on, extend, or go beyond the ADP Benchmarks.

Almost all of the ADP Benchmarks are included in the CCSS.

One ADP Benchmark is not included in the CCSS.

In some areas, the CCSS build on the ADP Benchmarks. For example, where the ADP Benchmarks expect students to work with a variety of algebraic expressions, the CCSS also expect students to reason about the structure of expressions prior to working with them. In other areas, both the CCSS and the ADP Benchmarks are rigorous yet take different approaches. For example, the ADP Benchmarks embed conceptual understanding in language that is more easily measured on a large-scale assessment. The CCSS explicitly write concepts as their own standards, and more clearly guide teachers in their work with students.

Background: The Common Core State Standards

The CCSS are designed to prepare all students for entry into credit-bearing college course work and entry-level jobs and career pathways that may require further education and training. The CCSS also describe the content needed by students who intend to study more advanced mathematics— including STEM fields or other mathematics-intensive courses of study or technical careers. The additional mathematics that students should learn in order to take advanced courses such as calculus, advanced statistics, or discrete mathematics is indicated by the symbol (+). Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (*). The CCSS are (1) research and evidence based, (2) aligned with college and work expectations, (3) rigorous, and (4) internationally benchmarked. The CCSS describe grade-level mathematics expectations for grades K-8. In high school, the expectations are organized into the strands of Number and Quantity, Algebra, Functions, Modeling, Statistics and Probability, and Geometry.

In addition, there are eight standards of mathematical practice that apply across grades K-12:

- Make sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision
- Look for and make use of structure
- Look for and express regularity in repeated reasoning

Finally, the standards will be parsed into Model Mathematics Course Pathways—three courses in two separate sequences—that show potential designs for organizing the standards into courses which allow students to reach the level of college and career readiness.

The American Diploma Project Benchmarks

The American Diploma Project Benchmarks describe the knowledge and skills that students need to acquire by the end of high school in order to be college and career ready. Benchmarks denoted with an asterisk (*) are recommended for all students but required for those students who plan to take calculus in college. In addition, the ADP Benchmarks identify nine Mathematical Reasoning skills that are woven throughout the benchmarks in the following four content domains: Number Sense and Numerical Operations; Algebra; Geometry; and Data Interpretation, Statistics, and Probability. The ADP Benchmarks are accompanied by sample tasks from postsecondary faculty and employers that illustrate what students will encounter in college and on the job. They may be found at www.achieve.org.

About this Comparison

In the side-by-side chart that follows, the high school CCSS were compared to the ADP end-of-high-school benchmarks. In some cases, the CCSS from lower grades were used if relevant high school standards could not be found. The ADP Benchmarks are found in the first column, and the CCSS that are aligned to these standards are found in the second column. The third column includes comments on how the CCSS meet and/or build upon the expectations described by the ADP Benchmarks. The CCSS for high school specify the mathematics that all students should learn in order to be college and career ready. Any standard *without* the (+) prefix is required for all students. The CCSS provide a roadmap of skills and knowledge that is more detailed than ADP.

The notation for the CCSS in this document is as follows:

Example CC.8.EE.1:
8 = grade level
EE = domain
1 = standard

In high school, the grade level is replaced with the following codes for the strands:

N = Number
A = Algebra
F = Function
S = Statistics and Probability
G = Geometry

All standards that are used in the side-by-side chart are from the CCSS for mathematics (released June 2, 2010). A complete list of standards that were not matched is included at the end of this document.

We hope this side-by-side comparison will be helpful to you as you consider the *Common Core State Standards (CCSS) for Mathematics (June 2010)*. Please let us know if you have any questions.

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A Comparison of the Common Core State Standards (CC) to the American Diploma Project (ADP) Benchmarks in Mathematics

American Diploma Project (ADP)	Common Core State Standards (CC)	Commentary
I. Number Sense and Numerical Operations - The high school graduate can:		
ADP I1. Compute with rational numbers fluently and accurately without a calculator:		
ADP I1.1. Add, subtract, multiply and divide integers, fractions and decimals.	**CC.5.NBT.7 Perform operations with multi-digit whole numbers and with decimals to hundredths.** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.	**Meets ADP:** Both sets of standards require students to compute with integers, fractions, and decimals.
	CC.6.NS.5 Apply and extend previous understandings of numbers to the system of rational numbers. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.	
	CC.7.NS.3 Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. Solve real-world and mathematical problems involving the four operations with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)	
ADP I1.2. Calculate and apply ratios, proportions, rates and percentages to solve problems.	**CC.6.RP.3b** Solve unit rate problems including those involving unit pricing and constant speed. For example, If it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?	**Meets ADP:** Both sets of standards require students to work with ratios, proportions, rates, and percentages.
	CC.6.RP.3c Find a percentage of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole given a part and the percentage.	
	CC.6.RP.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	
	CC.7.RP.2 Analyze proportional relationships and use them to solve real-world and mathematical problems. Recognize and represent proportional relationships between quantities.	
	CC.7.RP.3 Analyze proportional relationships and use them to solve real-world and mathematical problems. Use proportional relationships to solve	

American Diploma Project (ADP)	Common Core State Standards (CC)	Commentary
	multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.	
ADP I1.3. Use the correct order of operations to evaluate arithmetic expressions, including those containing parentheses.	**CC.6.EE.1 Apply and extend previous understandings of arithmetic to algebraic expressions.** Write and evaluate numerical expressions involving whole-number exponents.	**Builds on and extends ADP:** This CCSS goes beyond ADP by requiring students to see structure in expressions as well as evaluate them.
	CC.6.EE.2c Evaluate expressions by substituting values for their variables. Include expressions that arise from formulas in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). For example, use the formulas $V = s^3$ and $A = 6 s^2$ to find the volume and surface area of a cube with sides of length s = 1/2.	
	CC.6.EE.3 Apply and extend previous understandings of arithmetic to algebraic expressions. Apply the properties of operations to generate equivalent expressions. For example, apply the distributive property to the expression 3(2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.	
	CC.7.EE.2 Use properties of operations to generate equivalent expressions. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."	
	CC.8.EE.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.	
ADP I1.4. Explain and apply basic number theory concepts such as prime number, factor, divisibility, least common multiple and greatest common divisor.	**CC.4.OA.4 Gain familiarity with factors and multiples.** Find all factor pairs for a whole number in the range 1-100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1-100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1-100 is prime or composite.	**Meets ADP:** While least common multiple and greatest common divisor are not explicitly mentioned in the CCSS, their use is required in dealing with fractions and expressions.
	CC.4.NF.2 Extend understanding of fraction equivalence and ordering. Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the	

American Diploma Project (ADP)	Common Core State Standards (CC)	Commentary
	results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. (Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.)	
	CC.5.NF.1 Use equivalent fractions as a strategy to add and subtract fractions. Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)	
	CC.5.NF.2 Use equivalent fractions as a strategy to add and subtract fractions. Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. For example, recognize an incorrect result 2/5 + 1/2 = 3/7 by observing that 3/7 < 1/2.	
	CC.6.NS.4 Compute fluently with multi-digit numbers and find common factors and multiples. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. For example, express 36 + 8 as 4 (9 + 2).	
	CC.8.EE.1 Work with radicals and integer exponents. Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{(-5)} = 3^{(-3)} = 1/(3^3) = 1/27$.	
ADP I1.5. Multiply and divide numbers expressed in scientific notation.	**CC.8.EE.3 Work with radicals and integer exponents.** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3×10^8 and the populationof the world as 7×10^9, and determine that the world population is morethan 20 times larger.	**Builds on and extends ADP:** This CCSS includes an additional emphasis on the choice of unit and interpreting results of technology.
	CC.8.EE.4 Work with radicals and integer exponents. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret	

American Diploma Project (ADP)	Common Core State Standards (CC)	Commentary
	scientific notation that has been generated by technology.	
ADP I2. Recognize and apply magnitude (absolute value) and ordering of real numbers:		
ADP I2.1. Locate the position of a number on the number line, know that its distance from the origin is its absolute value and know that the distance between two numbers on the number line is the absolute value of their difference.	**CC.6.NS.6 Apply and extend previous understandings of numbers to the system of rational numbers.** Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.	**Builds on and extends ADP:** The number line is used through the grades K-8 CCSS as a model for understanding the relative magnitudes of numbers. These standards are the most rigorous among the set, including the placement of any irrational number (beyond roots) on the number line.
	CC.6.NS.6a Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite.	
	CC.6.NS.7c Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. For example, for an account balance of –30 dollars, write |–30| = 30 to describe the size of the debt in dollars.	
	CC.7.NS.1b Understand p + q as the number located a distance |q| from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.	
	CC.7.NS.1c Understand subtraction of rational numbers as adding the additive inverse, p – q = p + (–q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.	
	CC.8.NS.2 Know that there are numbers that are not rational, and approximate them by rational numbers. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). For example, by truncating the decimal expansion of √2 (square root of 2), show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.	
ADP I2.2. Determine the relative position on the number line of numbers and the relative magnitude of numbers expressed in fractional form, in decimal form, as roots	**CC.6.NS.6 Apply and extend previous understandings of numbers to the system of rational numbers.** Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative	**Builds on and extends ADP:** The number line is used through the grades K-8 CCSS as a model for understanding the

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or in scientific notation.	number coordinates.	relative magnitudes of numbers. These standards are the most rigorous among the set, including the placement of any irrational number (beyond roots) on the number line.
	CC.7.NS.1 Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.	
	CC.8.NS.2 Know that there are numbers that are not rational, and approximate them by rational numbers. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). For example, by truncating the decimal expansion of √2 (square root of 2), show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.	
ADP I3. Understand that to solve certain problems and equations, number systems need to be extended from whole numbers to the set of all integers (positive, negative and zero), from integers to rational numbers, from rational numbers to real numbers (rational and irrational numbers) and from real numbers to complex numbers; define and give examples of each of these types of numbers.	**CC.6.NS.5 Apply and extend previous understandings of numbers to the system of rational numbers.** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.	**Meets ADP:** While the CCSS use the number line to demonstrate the increase in number sets, rather than the need to solve certain problems, each number set through the reals is well represented in grades K-8. The introduction to high school Number and Quantity states, "During the years from kindergarten to eighth grade, students must repeatedly extend their conception of number," from counting, to whole, to fractions and decimals, to integers and negative rationals, to irrationals (reals), and finally to complex, which are part of the college- and career-ready core are shown here.
	CC.8.NS.2 Know that there are numbers that are not rational, and approximate them by rational numbers. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). For example, by truncating the decimal expansion of √2 (square root of 2), show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.	
	CC.9-12.N.CN.1 Perform arithmetic operations with complex numbers. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real.	
	CC.9-12.N.CN.7 Use complex numbers in polynomial identities and equations. Solve quadratic equations with real coefficients that have complex solutions.	
	CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for	

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	real numbers a and b.	
ADP I4. Understand the capabilities and the limitations of calculators and computers in solving problems:		
ADP I4.1. Use calculators appropriately and make estimations without a calculator regularly to detect potential errors.	**CC.4.OA.3 Use the four operations with whole numbers to solve problems.** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.	**Builds on and extends ADP:** A great deal of emphasis is placed on mental arithmetic in the early grades, with estimation used to check the reasonableness of results beginning in grade 5. Both sets of standards require students to use technology appropriately.
	CC.5.NF.2 Use equivalent fractions as a strategy to add and subtract fractions. Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. For example, recognize an incorrect result 2/5 + 1/2 = 3/7 by observing that 3/7 < 1/2.	
	CC.7.EE.3 Solve real-life and mathematical problems using numerical and algebraic expressions and equations. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations as strategies to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.	
	CC.K-12.MP.5 Use appropriate tools strategically. Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer algebra system, statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions	

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	generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.	
ADP I4.2. Use graphing calculators and computer spreadsheets.	**CC.9-12.S.ID.4 Summarize, represent, and interpret data on a single count or measurement variable.** Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	**Meets ADP:** The CCSS employ technology across all strands of high school mathematics.
	CC.9-12.F.IF.7 Analyze functions using different representations. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*	
	CC.K-12.MP.5 Use appropriate tools strategically. Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer algebra system, statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.	
J. Algebra - The high school graduate can:		

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ADP J1. Perform basic operations on algebraic expressions fluently and accurately:		
ADP J1.1. Understand the properties of integer exponents and roots and apply these properties to simplify algebraic expressions.	**CC.8.EE.1 Work with radicals and integer exponents.**Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.	**Builds on and extends ADP:** The CCSS require students to understand the connection between the laws for integer exponents and the associative law for multiplication.
	CC.8.EE.2 Work with radicals and integer exponents. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.	
	CC.9-12.N.RN.2 Extend the properties of exponents to rational exponents. Rewrite expressions involving radicals and rational exponents using the properties of exponents.	
ADP J1.2. * Understand the properties of rational exponents and apply these properties to simplify algebraic expressions.	**CC.9-12.N.RN.1 Extend the properties of exponents to rational exponents.** Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{(1/3)}$ to be the cube root of 5 because we want $[5(^{1/3)}]^3 = 5^{(1/3) \times 3}$ to hold, so $[5^{(1/3)}]^3$ must equal 5.	**Builds on and extends ADP:** The CCSS require students to understand and use the properties of rational exponents. In addition, this content, which is asterisked in the ADP, is required of all students in the CCSS.
	CC.9-12.N.RN.2 Extend the properties of exponents to rational exponents. Rewrite expressions involving radicals and rational exponents using the properties of exponents.	
	CC.9-12.N.RN.3 Use properties of rational and irrational numbers. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.	
	CC.9-12.F.IF.8b Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01^{(12t)}$, $y = 1.2^{(t/10)}$, and classify them as representing exponential growth and decay.	
	CC.9-12.A.SSE.3c Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $(1.15^{(1/12)})^{12t} \approx 1.012^{(12t)}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*	
ADP J1.3. Add, subtract and multiply polynomials; divide a polynomial by a low degree polynomial.	**CC.9-12.A.APR.1 Perform arithmetic operations on polynomials.** Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add,	**Builds on and extends ADP:** ADP does not explicitly mention the Remainder Theorem.

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	subtract, and multiply polynomials.	
	CC.9-12.A.APR.2 Understand the relationship between zeros and factors of polynomial. Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).	The CCSS specify the use of long division to accomplish division of polynomials; the ADP Benchmarks do not.
	CC.9-12.A.APR.6 Rewrite rational expressions. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.	
ADP J1.4. Factor polynomials by removing the greatest common factor; factor quadratic polynomials.	**CC.9-12.A.APR.1 Perform arithmetic operations on polynomials.** Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	**Builds on and extends ADP:** The CCSS include completing the square, seeing structure in expressions, and the practical reasons for factoring; the ADP Benchmarks do not.
	CC.9-12.A.SSE.3a Factor a quadratic expression to reveal the zeros of the function it defines.*	
	CC.9-12.F.IF.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	
	CC.9-12.F.IF.7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. *	
	CC.9-12.A.SSE.2 Interpret the structure of expressions. Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 – y^2)(x^2 + y^2)$.	
ADP J1.5. Add, subtract, multiply, divide and simplify rational expressions.	**CC.9-12.A.APR.6 Rewrite rational expressions.** Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.	**Meets ADP:** Both sets of standards similarly define student expectations in operations on rational expressions. However, in CCSS, the requirement to understand the system of rational expressions as analogous to rational numbers is identified as beyond the core.
	CC.9-12.A.APR.7 (+) **Rewrite rational expressions.** Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.	
ADP J1.6. Evaluate polynomial and rational expressions and expressions containing	**CC.8.F.1 Define, evaluate, and compare functions.** Understand that a function is a rule that assigns to each input exactly one output. The graph of a	**Meets ADP:** The CCSS do not call for the

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radicals and absolute values at specified values of their variables.	function is the set of ordered pairs consisting of an input and the corresponding output. (Function notation is not required in Grade 8.) **CC.9-12.F.IF.2 Understand the concept of a function and use function notation.** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **CC.9-12.A.REI.11 Represent and solve equations and inequalities graphically.** Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* **CC.9-12.A.REI.2 Understand solving equations as a process of reasoning and explain the reasoning.** Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	evaluation of expressions separate from functions except for the introduction to the grade 6 standards, "Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems." Rather, they call for the evaluation of expressions that define functions at specified values of their domains. The CCSS include polynomial, rational, absolute value, exponential, and logarithmic functions as the library of functions to use for graphing. Since "make tables of values" is specifically mentioned in the CCSS standard, it follows that students would be evaluating these functions at specific values.
ADP J1.7. * Derive and use the formulas for the general term and summation of finite arithmetic and geometric series; find the sum of an infinite geometric series whose common ratio, r, is in the interval (-1, 1).	**CC.9-12.F.BF.2** Build a function that models a relationship between two quantities. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.* **CC.9-12.F.LE.2 Construct and compare linear, quadratic, and exponential models and solve problems.** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). *	**Partially Meets ADP:** Both ADP and CCSS address applications of arithmetic and geometric sequences and series. However, CCSS does not specifically mention the formula for the sum of an infinite geometric series.

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	CC.9-12.F.IF.3 Understand the concept of a function and use function notation. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1 (n is greater than or equal to 1).	
	CC.9-12.A.SSE.4 Write expressions in equivalent forms to solve problems. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.*	
ADP J2. Understand functions, their representations and their properties:		
ADP J2.1 Recognize whether a relationship given in symbolic or graphical form is a function	**CC.8.F.1 Define, evaluate, and compare functions.** Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (Function notation is not required in Grade 8.)	**Builds on and extends ADP:** The CCSS require students to understand the definition of a function at a deeper level.
	CC.8.F.5 Use functions to model relationships between quantities. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	
	CC.9-12.F.IF.1 Understand the concept of a function and use function notation. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).	
ADP J2.2. * Determine the domain of a function represented in either symbolic or graphical form.	**CC.8.F.1 Define, evaluate, and compare functions.** Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (Function notation is not required in Grade 8.)	**Builds on and extends ADP**: The CCSS are more rigorous, as they require this content of all students; the ADP Benchmarks require this for calculus-intending students.
	CC.9-12.F.IF.1 Understand the concept of a function and use function notation. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).	
ADP J2.3. Understand functional notation and evaluate a function at a specified point	**CC.9-12.F.IF.2 Understand the concept of a function and use function notation.** Use function notation, evaluate functions for inputs in their	**Meets ADP:** Both sets of standards similarly

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in its domain.	domains, and interpret statements that use function notation in terms of a context.	define student expectations in the use of function notation and evaluation of a function for a specific domain value.
ADP J2.4. * Combine functions by composition, as well as by addition, subtraction, multiplication and division.	**CC.9-12.F.BF.1b** Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*	**Meets ADP:** Both ADP and CCSS require combination of functions by operating and composition.
	CC.9-12.F.BF.1c (+) **Compose functions.** For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*	
ADP J2.5. * Identify whether a function has an inverse and when functions are inverses of each other; explain why the graph of a function and its inverse are reflections of one another over the line y = x.	**CC.9-12.F.BF.4 Build new functions from existing functions.** Find inverse functions.	**Builds on and extends ADP:** The CCSS require students to have a deeper understanding of the nature of invertible functions and what it means to determine their inverses.
	CC.9-12.F.BF.4a Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) =2(x^3) or f(x) = (x+1)/(x-1) for x ≠ 1 (x not equal to 1).	
	CC.9-12.F.BF.4b (+) Verify by composition that one function is the inverse of another.	
	CC.9-12.F.BF.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.	
	CC.9-12.F.BF.4d (+) Produce an invertible function from a non-invertible function by restricting the domain.	
ADP J2.6. * Know the inverse of an exponential function is a logarithm, prove basic properties of a logarithm using properties of its inverse and apply those properties to solve problems.	**CC.9-12.F.BF.4 Build new functions from existing functions.** Find inverse functions.	**Builds on and extends ADP:** ADP expects STEM-intending students to use the properties of logarithms to solve problems involving exponential functions. The CCSS expects all students to be able to express the solution to an exponential equation as a logarithm.
	CC.9-12.F.BF.5 (+) **Build new functions from existing functions.** Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.	
	CC.9-12.F.LE.4 Construct and compare linear, quadratic, and exponential models and solve problems. For exponential models, express as a logarithm the solution to $ab^{(ct)}$ = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.*	
	CC.9-12.A.REI.11 Represent and solve equations and inequalities graphically. Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include	

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	cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*	
ADP J3. Apply basic algebraic operations to solve equations and inequalities:		
ADP J3.1. Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.	**CC.8.EE.7 Analyze and solve linear equations and pairs of simultaneous linear equations.** Solve linear equations in one variable.	**Partially meets ADP:** Both sets of standards expect students to solve linear equations and inequalities. The CCSS does not limit to linear inequalities, but it does not include equations including the absolute value of a linear function.
	CC.8.EE.7a Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).	
	CC.8.EE.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.	
	CC.9-12.A.REI.3 Solve equations and inequalities in one variable. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	
	CC.9-12.A.REI.10 Represent and solve equations and inequalities graphically. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	
	CC.9-12.A.CED.1 Create equations that describe numbers or relationship. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*	
	CC.9-12.A.CED.3 Create equations that describe numbers or relationship. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*	
ADP J3.2. Solve an equation involving several variables for one variable in terms of the others.	**CC.9-12.A.REI.1 Understand solving equations as a process of reasoning and explain the reasoning.** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.	**Builds on and extends ADP:** The CCSS articulate the need for students use logical deductions on solving equations.
	CC.9-12.A.CED.4 Create equations that describe numbers or relationship. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to	

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	highlight resistance R.*	
J3.3. Solve systems of two linear equations in two variables.	**CC.9-12.A.REI.5 Solve systems of equations.** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.	**Builds on and extends ADP:** By more clearly stating the underlying concepts of systems of equations and including nonlinear systems, the CCSS go beyond ADP.
	CC.9-12.A.REI.6 Solve systems of equations. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	
	CC.9-12.A.REI.7 Solve systems of equations. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.	
ADP J3.4. * Solve systems of three linear equations in three variables.	**CC.9-12.A.REI.8** (+) **Solve systems of equations.** Represent a system of linear equations as a single matrix equation in a vector variable.	**Builds on and extends ADP:** The CCSS expect students to solve systems of three linear equations in three variables, and they expect students to use matrices in the solution process.
	CC.9-12.A.REI.9 (+) **Solve systems of equations.** Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).	
ADP J3.5. Solve quadratic equations in one variable.	**CC.9-12.A.REI.4 Solve equations and inequalities in one variable.** Solve quadratic equations in one variable.	**Builds on and extends ADP:** The CCSS require students to use a variety of methods in solving quadratic equations, Additionally, the CCSS require all students to solve quadratic equations that have complex solutions.
	CC.9-12.A.REI.4a Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.	
	CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.	
	CC.9-12.N.CN.7 Use complex numbers in polynomial identities and equations. Solve quadratic equations with real coefficients that have complex solutions.	
ADP J4. Graph a variety of equations and inequalities in two variables, demonstrate understanding of the relationships between the algebraic properties of an equation and the geometric properties of its graph, and interpret a graph:		
ADP J4.1. Graph a linear equation and demonstrate that it has a constant rate of change.	**CC.9-12.F.IF.7a** Graph linear and quadratic functions and show intercepts, maxima, and minima.*	**Meets ADP:** Both sets of standards require students to graph linear
	CC.9-12.F.LE.1b. Recognize situations in which one quantity changes at a	

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	constant rate per unit interval relative to another.*	equations and to examine their rates of change.
ADP J4.2. Understand the relationship between the coefficients of a linear equation and the slope and x- and y-intercepts of its graph.	**CC.8.EE.6 Understand the connections between proportional relationships, lines, and linear equations.** Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y =mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.	**Builds on and extends ADP:** The CCSS make clear this content should be learned by the end of middle school.
	CC.8.F.3 Define, evaluate, and compare functions. Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.	
	CC.9-12.A.SSE.1a Interpret parts of an expression, such as terms, factors, and coefficients.*	
ADP J4.3. Understand the relationship between a solution of a system of two linear equationsin two variables and the graphs of the corresponding lines.	**CC.8.EE.8a** Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.	**Meets ADP:** Both sets of standards make clear the relationship between a system's solution and its graph.
	CC.9-12.A.REI.7 Solve systems of equations. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = –3x$ and the circle $x^2 + y^2 = 3$.	
ADP J4.4. Graph the solution set of a linear inequality and identify whether the solution set is an open or a closed half-plane; graph the solution set of a system of two or three linear inequalities.	**CC.9-12.A.CED.3 Create equations that describe numbers or relationship.** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*	**Builds on and extends ADP:** Both sets of standards require similar expectations of students with respect to linear inequalities. However, the CCSS does not limit to linear inequalities.
	CC.9-12.A.REI.3 Solve equations and inequalities in one variable. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	
	CC.9-12.A.REI.10 Represent and solve equations and inequalities graphically. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	
	CC.9-12.A.REI.12 Represent and solve equations and inequalities graphically. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the	

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	solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	
ADP J4.5. Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph.	**CC.9-12.A.SSE.3a** Factor a quadratic expression to reveal the zeros of the function it defines.*	**Builds on and extends ADP:** By explicating the purposeful transformation of quadratics polynomials to reveal information, these CCSS extend ADP.
	CC.9-12.F.IF.7a Graph linear and quadratic functions and show intercepts, maxima, and minima.*	
	CC.9-12.F.IF.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	
	CC.9-12.F.IF.9 Analyze functions using different representations. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.	
ADP J4.6. * Graph ellipses and hyperbolas whose axes are parallel to the x and y axes and demonstrate understanding of the relationship between their standard algebraic form and their graphical characteristics.	**CC.9-12.G.GPE.3** (+) **Translate between the geometric description and the equation for a conic section.** Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.	**Meets ADP:** Both sets of standards require students to work with ellipses and hyperbolas, both graphically and algebraically.
ADP J4.7. Graph exponential functions and identify their key characteristics.	**CC.9-12.F.IF.7e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*	**Builds on and extends ADP:** Both sets of standards have similar expectations around the graphs of exponential functions, with the CCSS building on ADP by including logarithmic functions.
	CC.9-12.A.REI.11 Represent and solve equations and inequalities graphically. Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*	
ADP J4.8. Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem.	**CC.9-12.N.Q.1 Reason quantitatively and use units to solve problems.** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*	**Meets ADP:** Both sets of standards expect students to draw pertinent information from graphs.
	CC.9-12.A.APR.3 Understand the relationship between zeros and factors of polynomials. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function	

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	defined by the polynomial.	
	CC.9-12.F.IF.7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. *	
	CC.9-12.F.IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. *	
	CC.9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*	
	CC.9-12.F.IF.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	
	CC.9-12.F.IF.4 Interpret functions that arise in applications in terms of the context. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*	
	CC.9-12.F.IF.5 Interpret functions that arise in applications in terms of the context. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*	
ADP J5. Solve problems by converting the verbal information given into an appropriate mathematical model involving equations or systems of equations; apply appropriate mathematical techniques to analyze these mathematical models; and interpret the solution obtained in written form using appropriate units of measurement:		
ADP J5.1. Recognize and solve problems that can be modeled using a linear equation in one variable, such as time/rate/distance problems, percentage increase or decrease problems, and ratio and proportion problems.	**CC.9-12.F.LE.1 Construct and compare linear, quadratic, and exponential models and solve problems.** Distinguish between situations that can be modeled with linear functions and with exponential functions.*	**Builds on and extends ADP:** Both sets of standards expect students to apply linear functions to solve problems. The CCSS also requires recognition of and comparison to other models.
	CC.9-12.F.LE.3 Construct and compare linear, quadratic, and exponential models and solve problems. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*	
	CC.9-12.F.LE.5 Interpret expressions for functions in terms of the situation they model. Interpret the parameters in a linearor exponential function in terms of a context.*	
	CC.9-12.F.BF.1 Build a function that models a relationship between two	

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	quantities. Write a function that describes a relationship between two quantities.*	
ADP J5.2. Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.	**CC.9-12.A.CED.3 Create equations that describe numbers or relationship.** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*	**Builds on and extends ADP:** Both sets of standards expect students to use systems of equations in the modeling process. However, the CCSS include inequalities and systems of inequalities and require interpretation of solutions.
	CC.9-12.F.BF.1 Build a function that models a relationship between two quantities. Write a function that describes a relationship between two quantities.*	
ADP J5.3. Recognize and solve problems that can be modeled using a quadratic equation, such as the motion of an object under the force of gravity.	**CC.9-12.F.LE.1 Construct and compare linear, quadratic, and exponential models and solve problems.** Distinguish between situations that can be modeled with linear functions and with exponential functions.*	**Builds on and extends ADP:** Both sets of standards expect students to use quadratics in the modeling process. The CCSS also requires recognition of and comparison to other models.
	CC.9-12.F.LE.3 Construct and compare linear, quadratic, and exponential models and solve problems. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*	
	CC.9-12.F.LE.5 Interpret expressions for functions in terms of the situation they model. Interpret the parameters in a linear, quadratic, or exponential function in terms of a context. *	
	CC.9-12.F.BF.1 Build a function that models a relationship between two quantities. Write a function that describes a relationship between two quantities.*	
ADP J5.4. Recognize and solve problems that can be modeled using an exponential function, such as compound interest problems.	**CC.9-12.F.LE.1 Construct and compare linear, quadratic, and exponential models and solve problems.** Distinguish between situations that can be modeled with linear functions and with exponential functions.*	**Builds on and extends ADP:** Both sets of standards expect students to use exponential functions in the modeling process. These CCSS extend ADP by explicitly requiring students connect each part of the exponential function to the situation. The CCSS also requires recognition of and comparison to other models.
	CC.9-12.F.LE.3 Construct and compare linear, quadratic, and exponential models and solve problems. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*	
	CC.9-12.F.LE.5 Interpret expressions for functions in terms of the situation they model. Interpret the parameters in a linearor exponential function in terms of a context.*	
	CC.9-12.F.BF.1 Build a function that models a relationship between two quantities. Write a function that describes a relationship between two quantities.*	

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ADP J5.5. * Recognize and solve problems that can be modeled using an exponential function but whose solution requires facility with logarithms, such as exponential growth and decay problems.	**CC.9-12.A.REI.11 Represent and solve equations and inequalities graphically.** Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*	**Builds on and extends ADP:** Both sets of standards expect students to model with exponential functions. While ADP requires the use of logarithmic properties in the solutions to exponential equations, the CCSS also address for all students logarithmic functions as models.
	CC.9-12.F.LE.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*	
	CC.9-12.F.LE.4 Construct and compare linear, quadratic, and exponential models and solve problems. For exponential models, express as a logarithm the solution to a $b^{(ct)}$ = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.*	
	CC.9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*	
ADP J5.6. Recognize and solve problems that can be modeled using a finite geometric series, such as home mortgage problems and other compound interest problems.	**CC.9-12.F.BF.2 Build a function that models a relationship between two quantities.** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*	**Meets ADP:** Both sets of standards expect students to model using geometric series.
	CC.9-12.A.SSE.3c Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $[1.15^{1/12}]^{12t} \approx 1.012^{(12t)}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*	
	CC.9-12.A.SSE.4 Write expressions in equivalent forms to solve problems. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.*	
	CC.9-12.F.BF.1 Build a function that models a relationship between two quantities. Write a function that describes a relationship between two quantities.*	
	CC.9-12.F.BF.1a Determine an explicit expression, a recursive process, or steps for calculation from a context.*	
ADP J6. * Understand the binomial theorem and its connections to combinatorics, Pascal's triangle and probability.	**CC.9-12.A.APR.5** (+) **Use polynomial identities to solve problems.** Know and apply that the Binomial Theorem gives the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle. (The Binomial	**Meets ADP:** Both sets of standards expect STEM-students to understand and use the Binomial Theorem.

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	Theorem can be proved by mathematical induction or by a combinatorial argument.)	
K. Geometry - The high school graduate can:		
ADP K1. Understand the different roles played by axioms, definitions and theorems in the logical structure of mathematics, especially in geometry:		
ADP K1.1. Identify, explain the necessity of and give examples of definitions, axioms and theorems.	**CC.9-12.G.CO.1 Experiment with transformations in the plane.** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	**Meets ADP:** Students are required to know and use definitions and axioms, and to prove theorems.
	CC.9-12.G.CO.7 Understand congruence in terms of rigid motions. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	
	CC.9-12.G.SRT.2 Understand similarity in terms of similarity transformations. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	
ADP K1.2. State and prove key basic theorems in geometry such as the Pythagorean theorem, the sum of the angles of a triangle is 180 degrees, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length.	**CC.8.G.6 Understand and apply the Pythagorean Theorem.** Explain a proof of the Pythagorean Theorem and its converse.	**Builds on and extends ADP:** Both sets of standards expect students to prove basic geometric theorems. The CCSS also requires coordinate proof.
	CC.9-12.G.CO.9 Prove geometric theorems. Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	
	CC.9-12.G.CO.10 Prove geometric theorems. Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180 degrees; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.	
	CC.9-12.G.CO.11 Prove geometric theorems. Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.	
	CC.9-12.G.SRT.4 Prove theorems involving similarity. Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved	

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	using triangle similarity.	
	CC.9-12.G.SRT.5 Prove theorems involving similarity. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	
	CC.9-12.G.GPE.5 Use coordinates to prove simple geometric theorems algebraically. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	
	CC.9-12.G.GPE.6 Use coordinates to prove simple geometric theorems algebraically. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	
ADP K1.3. Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true.		**No match:** The CCSS do not explicitly address non-Euclidean geometry.
ADP K2. Identify and apply the definitions related to lines and angles and use them to prove theorems in (Euclidean) geometry, solve problems, and perform basic geometric constructions using a straight edge and compass:		
ADP K2.1. Identify and apply properties of and theorems about parallel lines and use them to prove theorems such as two lines parallel to a third are parallel to each other and to perform constructions such as a line parallel to a given line through a point not on the line.	**CC.8.G.5 Understand congruence and similarity using physical models, transparencies, or geometry software.** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so.	**Meets ADP:** Both sets of standards expect students to work with the properties and theorems associated with parallel lines.
	CC.9-12.G.CO.9 Prove geometric theorems. Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	
	CC.9-12.G.CO.12 Make geometric constructions. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	
ADP K2.2. Identify and apply properties of	**CC.9-12.G.GPE.4 Use coordinates to prove simple geometric theorems**	**Meets ADP:**

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and theorems about perpendicular lines and use them to prove theorems such as the perpendicular bisectors of line segments are the set of all points equidistant from the two end points and to perform constructions such as the perpendicular bisector of a line segment.	**algebraically.** For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).	Both sets of standards expect students to work with the properties and theorems associated with perpendicular lines.
	CC.9-12.G.GPE.5 Use coordinates to prove simple geometric theorems algebraically. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	
	CC.9-12.G.CO.12 Make geometric constructions. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	
ADP K2.3. Identify and apply properties of and theorems about angles and use them to prove theorems such as two lines are parallel exactly when the alternate interior angles they make with a transversal are equal and to perform constructions such as the bisector of an angle.	**CC.8.G.5 Understand congruence and similarity using physical models, transparencies, or geometry software.** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so.	**Meets ADP:** Both sets of standards expect students to work with the properties and theorems associated with angles.
	CC.9-12.G.CO.9 Prove geometric theorems. Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	
	CC.9-12.G.CO.12 Make geometric constructions. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	
ADP K3. Know the basic theorems about congruent and similar triangles and use them to prove additional theorems and	**CC.8.G.5 Understand congruence and similarity using physical models, transparencies, or geometry software.** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles	**Builds on and extends ADP:** The treatment given to similarity by the CCSS is

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solve problems.	created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the three angles appear to form a line, and give an argument in terms of transversals why this is so.	extensive and deep. Students first develop a strong understanding of congruence and similarity via rigid transformations, which builds to dilations and similarity.
	CC.9-12.G.CO.8 Understand congruence in terms of rigid motions. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.	
	CC.9-12.G.CO.10 Prove geometric theorems. Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180 degrees; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.	
	CC.9-12.G.SRT.1 Understand similarity in terms of similarity transformations. Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	
ADP K4. Know the definitions and basic properties of a circle and use them to prove basic theorems and solve problems.	**CC.9-12.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically.** For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point (0, 2).	**Meets ADP:** Both sets of standards require students to know and work with basic properties and theorems of circles. For STEM-intending students, the CCSS include specific theorems and constructions using circles, in addition.
	CC.9-12.G.C.1 Understand and apply theorems about circles. Prove that all circles are similar.	
	CC.9-12.G.C.2 Understand and apply theorems about circles. Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	
	CC.9-12.G.C.3 Understand and apply theorems about circles. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	
	CC.9-12.G.C.4 (+) **Understand and apply theorems about circles.** Construct a tangent line from a point outside a given circle to the circle.	
	CC.9-12.G.C.5 Find arc lengths and areas of sectors of circles. Derive using	

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	similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.	
ADP K5. Apply the Pythagorean theorem, its converse and properties of special right triangles to solve problems.	**CC.8.G.6 Understand and apply the Pythagorean Theorem.** Explain a proof of the Pythagorean Theorem and its converse.	**Meets ADP:** Both sets of standards require students to understand and apply the Pythagorean Theorem, the CCSS in late middle school standards.
	CC.8.G.7 Understand and apply the Pythagorean Theorem. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	
	CC.8.G.8 Understand and apply the Pythagorean Theorem. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	
ADP K6. Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent and to create and analyze geometric designs.	**CC.9-12.G.SRT.5 Prove theorems involving similarity.** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	**Meets ADP:** In both sets of standards, students relate congruence and rigid transformations.
	CC.9-12.G.CO.1 Experiment with transformations in the plane. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	
	CC.9-12.G.CO.2 Experiment with transformations in the plane. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).	
	CC.9-12.G.CO.3 Experiment with transformations in the plane. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.	
	CC.9-12.G.CO.4 Experiment with transformations in the plane. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	
	CC.9-12.G.CO.5 Experiment with transformations in the plane. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.	
	CC.9-12.G.CO.6 Understand congruence in terms of rigid motions. Use geometric descriptions of rigid motions to transform figures and to predict	

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	the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.	
	CC.9-12.G.CO.7 Understand congruence in terms of rigid motions. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	
ADP K7. Know about the similarity of figures and use the scale factor to solve problems.	**CC.9-12.G.SRT.1 Understand similarity in terms of similarity transformations.** Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	**Builds on and extends ADP:** The use of dilations in the CCSS progresses to a deeper level of understanding of similarity in high school.
	CC.9-12.G.SRT.2 Understand similarity in terms of similarity transformations. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	
	CC.9-12.G.SRT.3 Understand similarity in terms of similarity transformations. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	
ADP K8. Know that geometric measurements (length, area, perimeter, volume) depend on the choice of a unit and that measurements made on physical objects are approximations; calculate the measurements of common plane and solid geometric figures:		
ADP K8.1. Understand that numerical values associated with measurements of physical quantities must be assigned units of measurement or dimensions; apply such units correctly in expressions, equations and problem solutions that involve measurements; and convert a measurement using one unit of measurement to another unit of measurement.	**CC.5.MD.1 Convert like measurement units within a given measurement system.** Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step real world problems.	**Builds on and extends ADP:** The treatment given to quantitative reasoning by the CCSS is extensive and deep, beginning with unit conversion in middle school and extending to unit analysis in high school.
	CC.6.RP.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	
	CC.9-12.N.Q.1 Reason quantitatively and use units to solve problems. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*	
	CC.9-12.N.Q.2 Reason quantitatively and use units to solve problems. Define appropriate quantities for the purpose of descriptive modeling.*	

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	CC.9-12.N.Q.3 Reason quantitatively and use units to solve problems. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*	
ADP K8.2. Determine the perimeter of a polygon and the circumference of a circle; the area of a rectangle, a circle, a triangle and a polygon with more than four sides by decomposing it into triangles; the surface area of a prism, a pyramid, a cone and a sphere; and the volume of a rectangular box, a prism, a pyramid, a cone and a sphere.	**CC.7.G.4 Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.** Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.	**Builds on and extends ADP:** Both sets of standards treat the determination of basic measurements similarly. The CCSS goes beyond ADP in the high school standards by requiring students use coordinates to find measures and to argue in support of the use of certain measurement formulas.
	CC.7.G.6 Solve real-life and mathematical problems involving angle measure, area, surface area, and volume. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.	
	CC.9-12.G.GMD.1 Explain volume formulas and use them to solve problems. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.	
	CC.9-12.G.GMD.2 (+) **Explain volume formulas and use them to solve problems.** Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.	
	CC.9-12.G.GMD.3 Explain volume formulas and use them to solve problems. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*	
	CC.9-12.G.GPE.7 Use coordinates to prove simple geometric theorems algebraically. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*	
ADP K8.3. Know that the effect of a scale factor k on length, area and volume is to multiply each by k, k^2 and k^3, respectively.	**CC.7.G.1 Draw, construct, and describe geometrical figures and describe the relationships between them.** Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	**Partially meets ADP:** The CCSS does not explicitly extend the effect of a change in length in terms of k2 and k3. However, it does expect students to apply the concept in grade 7.
	CC.9-12.G.SRT.1 Understand similarity in terms of similarity transformations. Verify experimentally the properties of dilations given by a center and a scale factor: -- a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. -- b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	

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ADP K9. Visualize solids and surfaces in three-dimensional space when given two-dimensional representations (e.g., nets, multiple views) and create two-dimensional representations for the surfaces of three-dimensional objects.	**CC.6.G.4 Solve real-world and mathematical problems involving area, surface area, and volume.** Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.	**Builds on and extends ADP:** Both sets of standards have similar expectations for students in the area of visualization. However, CCSS goes beyond ADP by including cross-sections and volumes of rotation and by linking visualization to applications.
	CC.9-12.G.GMD.4 Visualize relationships between two-dimensional and three-dimensional objects. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	
ADP K10. Represent geometric objects and figures algebraically using coordinates; use algebra to solve geometric problems:		
ADP K10.1. Express the intuitive concept of the "slant" of a line in terms of the precise concept of slope, use the coordinates of two points on a line to define its slope, and use slope to express the parallelism and perpendicularity of lines.	**CC.8.EE.6 Understand the connections between proportional relationships, lines, and linear equations.** Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y =mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.	**Builds on and extends ADP:** Both sets of standards have similar expectations for students in the area of slope, with the CCSS including the connection of slope to similar triangles.
	CC.9-12.G.GPE.5 Use coordinates to prove simple geometric theorems algebraically. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	
ADP K10.2. Describe a line by a linear equation.	**CC.8.F.4 Use functions to model relationships between quantities.** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	**Meets ADP:** Both sets of standards have similar expectations for students in this area.
ADP K10.3. Find the distance between two points using their coordinates and the Pythagorean theorem.	**CC.6.G.3 Solve real-world and mathematical problems involving area, surface area, and volume.** Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.	**Meets ADP:** Both sets of standards have similar expectations for students in this area.
	CC.8.G.8 Understand and apply the Pythagorean Theorem. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	
	CC.9-12.G.GPE.7 Use coordinates to prove simple geometric theorems algebraically. Use coordinates to compute perimeters of polygons and areas	

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	of triangles and rectangles, e.g., using the distance formula.*	
ADP K10.4. * Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.	**CC.9-12.G.GPE.1 Translate between the geometric description and the equation for a conic section.** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	**Builds on and extends ADP:** Both sets of standards have similar expectations for students regarding the equation of a circle, with the CCSS requiring all students to complete the square on a quadratic equation to find the radius of a circle.
ADP K11. Understand basic right-triangle trigonometry and apply it to solve problems:		
ADP K11.1. Understand how similarity of right triangles allows the trigonometric functions sine, cosine and tangent to be defined as ratios of sides and be able to use these functions to solve problems.	**CC.9-12.G.SRT.6 Define trigonometric ratios and solve problems involving right triangles.** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	**Meets ADP:** Both sets of standards have similar expectations for students regarding the development of the trigonometric ratios.
	CC.9-12.G.SRT.7 Define trigonometric ratios and solve problems involving right triangles. Explain and use the relationship between the sine and cosine of complementary angles.	
	CC.9-12.G.SRT.8 Define trigonometric ratios and solve problems involving right triangles. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	
ADP K11.2. Apply the trigonometric functions sine, cosine and tangent to solve for an unknown length of a side of a right triangle, given one of the acute angles and the length of another side.	**CC.9-12.G.SRT.8 Define trigonometric ratios and solve problems involving right triangles.** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	**Meets ADP:** Both sets of standards have similar expectations for students regarding the use of trigonometric ratios.
ADP K11.3. Use the standard formula for the area of a triangle, *A* = ½bh, to explain the area formula, *A* = ½absinC where a and b are the lengths of two sides of a triangle and C is the measure of the included angle formed by these two sides, and use it to find the area of a triangle when given the lengths of two of its sides and the included angle.	**CC.9-12.G.SRT.9** (+) **Apply trigonometry to general triangles.** Derive the formula A = (1/2)ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.	**Partially Meets ADP:** Both sets of standards have similar expectations for students regarding the use the trigonometric version of the area of triangle, although the CCSS require them for STEM-intending students.
ADP K12. * Know how the trigonometric functions can be extended to periodic functions on the real line, derive basic formulas involving these functions, and use these functions and formulas to solve problems:		

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ADP K12.1. * Know that the trigonometric functions sine and cosine, and thus all trigonometric functions, can be extended to periodic functions on the real line by defining them as functions on the unit circle, that radian measure of an angle between 0 and 360 degrees is the arc length of the unit circle subtended by that central angle, and that by similarity, the arc length s of a circle of radius r subtended by a central angle of measure t radians is s = rt.	**CC.9-12.F.TF.1 Extend the domain of trigonometric functions using the unit circle.** Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	**Meets ADP:** Both sets of standards expect students to develop an understanding of trigonometric functions using radians and the unit circle, with the CCSS requiring knowledge of the unit circle and radian measure for all students. The CCSS also include relating these functions to their inverses.
	CC.9-12.F.TF.2 Extend the domain of trigonometric functions using the unit circle. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	
	CC.9-12.F.TF.3 (+) E**xtend the domain of trigonometric functions using the unit circle.** Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π - x, π + x, and 2π - x in terms of their values for x, where x is any real number.	
	CC.9-12.F.TF.4 (+) **Extend the domain of trigonometric functions using the unit circle.** Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.	
	CC.9-12.F.TF.6 (+) **Model periodic phenomena with trigonometric functions.** Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.	
	CC.9-12.G.C.5 Find arc lengths and areas of sectors of circles. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.	
K12.2. * Know and use the basic identities, such as $\sin^2(x) + \cos^2(x) = 1$ and $\cos((\pi/2) - x) = \sin(x)$ and formulas for sine and cosine, such as addition and double angle formulas.	**CC.9-12.F.TF.8 Prove and apply trigonometric identities.** Prove the Pythagorean identity (sin A)^2 + (cos A)^2 = 1 and use it to calculate trigonometric ratios.	**Builds on and extends ADP:** Both sets of standards require the use of trigonometric identities in solving problems, ADP for STEM students and CCSS for all. The CCSS also requires proof of formulas.
	CC.9-12.F.TF.9 (+) **Prove and apply trigonometric identities.** Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.	
K12.3. * Graph sine, cosine and tangent as well as their reciprocals, secant, cosecant and cotangent; identify key characteristics.	**CC.9-12.F.IF.7e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*	**Builds on and extends ADP:** Both sets of standards have similar expectations for students regarding the graphing of trigonometric functions, with the CCSS expecting all students to model all periodic phenomena and to analyze
	CC.9-12.F.TF.5 Model periodic phenomena with trigonometric functions. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*	
	CC.9-12.F.TF.6 (+) **Model periodic phenomena with trigonometric functions.** Understand that restricting a trigonometric function to a domain on which it	

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	is always increasing or always decreasing allows its inverse to be constructed.	their graphs.
	CC.9-12.F.TF.7 (+) **Model periodic phenomena with trigonometric functions.** Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.*	
K12.4. * Know and use the law of cosines and the law of sines to find missing sides and angles of a triangle.	**CC.9-12.G.SRT.10** (+) **Apply trigonometry to general triangles.** Prove the Laws of Sines and Cosines and use them to solve problems.	**Builds on and extends ADP:** The treatment given to the law of cosines and law of sines by the CCSS is deeper and more extensive than seen in ADP.
	CC.9-12.G.SRT.11 (+) **Apply trigonometry to general triangles.** Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).	
L. Data Interpretation, Statistics and Probability - The high school graduate can:		
ADP L1. Explain and apply quantitative information:		
ADP L1.1. Organize and display data using appropriate methods (including spreadsheets) to detect patterns and departures from patterns.	**CC.6.SP.4 Summarize and describe distributions.** Display numerical data in plots on a number line, including dot plots, histograms, and box plots.	**Meets ADP:** Both sets of standards have similar expectations for students regarding the displaying and organizing of data.
	CC.8.SP.4 Investigate patterns of association in bivariate data. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?	
ADP L1.2. Read and interpret tables, charts and graphs.	**CC.8.SP.1 Investigate patterns of association in bivariate data.** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	**Builds on and extends ADP:** Because they are far more specific in this area, the CCSS document has deeper expectations for student learning.
	CC.8.SP.2 Investigate patterns of association in bivariate data. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.	
	CC.9-12.S.ID.1 Summarize, represent, and interpret data on a single count or measurement variable. Represent data with plots on the real number line	

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	(dot plots, histograms, and box plots). *	
ADP L1.3. Compute and explain summary statistics for distributions of data including measures of center (mean, median) and spread (range, percentiles, variance, standard deviation).	**CC.9-12.S.ID.2 Summarize, represent, and interpret data on a single count or measurement variable.** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*	**Meets ADP:** Both sets of standards have similar expectations for students in this area.
	CC.9-12.S.ID.3 Summarize, represent, and interpret data on a single count or measurement variable. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*	
	CC.9-12.S.ID.5 Summarize, represent, and interpret data on two categorical and quantitative variables. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.*	
	CC.9-12.S.ID.6 Summarize, represent, and interpret data on two categorical and quantitative variables. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*	
ADP L1.4. Compare data sets using graphs and summary statistics.	**CC.7.SP.3 Draw informal comparative inferences about two populations.** Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.	**Meets ADP:** Both sets of standards have similar expectations for students in this area.
	CC.9-12.S.ID.2 Summarize, represent, and interpret data on a single count or measurement variable. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*	
ADP L1.5. Create scatter plots, analyze patterns and describe relationships in paired data.		**Builds on and extends ADP:** Both sets of standards have similar expectations for students in this area, although the CCSS is somewhat more specific in the expectations around interpretation.

CC.8.SP.4Investigate patterns of association in bivariate data. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For

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	home. Is there evidence that those who have a curfew also tend to have chores?	
	CC.9-12.S.ID.1 Summarize, represent, and interpret data on a single count or measurement variable. Represent data with plots on the real number line (dot plots, histograms, and box plots).*	
	CC.9-12.S.ID.6 Summarize, represent, and interpret data on two categorical and quantitative variables. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*	
ADP L1.6. Know the characteristics of the Gaussian normal distribution (bell-shaped curve).	**CC.9-12.S.ID.4 Summarize, represent, and interpret data on a single count or measurement variable.** Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.*	**Builds on and extends ADP:** The CCSS expect students to use the normal curve, and to be thoughtful about when they should be used, where ADP expects students simply to know the curve's characteristics.
ADP L2. Explain and critique alternative ways of presenting and using information:		
ADP L2.1. Evaluate reports based on data published in the media by considering the source of the data, the design of the study, and the way the data are analyzed and displayed.	**CC.9-12.S.IC.6 Make inferences and justify conclusions from sample surveys, experiments, and observational studies.** Evaluate reports based on data.*	**Partially Meets ADP:** Both sets of standards expect students to evaluate reports based on data, although ADP is somewhat more specific.
ADP L2.2. Identify and explain misleading uses of data.	**CC.9-12.S.IC.6 Make inferences and justify conclusions from sample surveys, experiments, and observational studies.** Evaluate reports based on data.*	**Partially Meets ADP:** Although the CCSS do not explicitly require students to identify and explain misleading uses of data as a standard, they do require students to evaluate reports based on data. In addition, the introduction to the statistics strand includes the following text, which attends to the meaning of the ADP Benchmark, "The conditions under which data are collected are important in drawing conclusions from the

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		data; in critically reviewing uses of statistics in public media and other reports, it is important to consider the study design, how the data were gathered, and the analyses employed as well as the data summaries and the conclusions drawn.”
ADP L2.3. Recognize when arguments based on data confuse correlation with causation.	**CC.9-12.S.ID.9 Interpret linear models.** Distinguish between correlation and causation.*	**Meets ADP:** Both sets of standards have similar expectations for students in this area.
ADP L3. Explain the use of data and statistical thinking to draw inferences, make predictions and justify conclusions:		
ADP L3.1. Explain the impact of sampling methods, bias and the phrasing of questions asked during data collection and the conclusions that can rightfully be made.	**CC.7.SP.1 Use random sampling to draw inferences about a population.** Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.	**Meets ADP:** Both sets of standards have similar expectations for students in this area, although ADP is clearer about bias.
	CC.7.SP.2 Use random sampling to draw inferences about a population. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.	
	CC.9-12.S.IC.1 Understand and evaluate random processes underlying statistical experiments. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*	
ADP L3.2. Design simple experiments or investigations to collect data to answer questions of interest.	**CC.7.SP.2 Use random sampling to draw inferences about a population.** Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on	**Partially Meets ADP:** ADP is somewhat more rigorous by requiring students to design experiments or investigations.

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	randomly sampled survey data. Gauge how far off the estimate or prediction might be.	
	CC.7.SP.8cDesign and use a simulation to generate frequencies for compound events. For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?	
	CC.9-12.S.IC.4 Make inferences and justify conclusions from sample surveys, experiments, and observational studies. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*	
	CC.9-12.S.IC.5 Make inferences and justify conclusions from sample surveys, experiments, and observational studies. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*	
ADP L3.3. Explain the differences between randomized experiments and observational studies.	**CC.9-12.S.IC.1 Understand and evaluate random processes underlying statistical experiments.** Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*	**Builds on and extends ADP:** Because they are far more specific in this area, the CCSS document has deeper expectations for student learning.
	CC.9-12.S.IC.2 Understand and evaluate random processes underlying statistical experiments. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0. 5. Would a result of 5 tails in a row cause you to question the model?*	
	CC.9-12.S.IC.3 Make inferences and justify conclusions from sample surveys, experiments, and observational studies. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*	
	CC.9-12.S.IC.4 Make inferences and justify conclusions from sample surveys, experiments, and observational studies. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*	
ADP L3.4. Construct a scatter plot of a set of paired data, and if it demonstrates a linear trend, use a graphing calculator to find the regression line that best fits this data; recognize that the correlation	**CC.9-12.S.ID.6a** Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.*	**Meets ADP:** Both sets of standards have similar expectations for students in this area, with CCSS being more specific.
	CC.9-12.S.ID.6b Informally assess the fit of a function by plotting and	

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coefficient measures goodness of fit and explain when it is appropriate to use the regression line to make predictions	analyzing residuals.*	
	CC.9-12.S.ID.6c Fit a linear function for a scatter plot that suggests a linear association.*	
	CC.9-12.S.ID.7 Interpret linear models. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*	
	CC.9-12.S.ID.8 Interpret linear models. Compute (using technology) and interpret the correlation coefficient of a linear fit.*	
	CC.9-12.S.ID.9 Interpret linear models. Distinguish between correlation and causation.*	
ADP L4. Explain and apply probability concepts and calculate simple probabilities:		
ADP L4.1. Explain how probability quantifies the likelihood that an event occurs in terms of numbers.	**CC.7.SP.5 Investigate chance processes and develop, use, and evaluate probability models.** Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.	**Meets ADP:** Both sets of standards have similar expectations for students in this area.
ADP L4.2. Explain how the relative frequency of a specified outcome of an event can be used to estimate the probability of the outcome.	**CC.7.SP.8c Design and use a simulation to generate frequencies for compound events.** For example, use random digits as a simulation tool to approximate the answer to the question: if 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?	**Meets ADP:** Both sets of standards have similar expectations for students in this area, with CCSS providing a more specific description of the relationship between frequency and probability.
	CC.8.SP.4 Investigate patterns of association in bivariate data. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?	
	CC.9-12.S.CP.4 Understand independence and conditional probability and use them to interpret data. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example,	

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	collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*	
ADP L4.3. Explain how the law of large numbers can be applied in simple examples.	**CC.7.SP.6 Investigate chance processes and develop, use, and evaluate probability models.** Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.	**Meets ADP:** Both sets of standards have similar expectations for students in this area.
	CC.7.SP.7 Investigate chance processes and develop, use, and evaluate probability models. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.	
	CC.9-12.S.IC.2 Understand and evaluate random processes underlying statistical experiments. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0. 5. Would a result of 5 tails in a row cause you to question the model?*	
ADP L4.4. Apply probability concepts such as conditional probability and independent events to calculate simple probabilities.	**CC.9-12.S.CP.5 Understand independence and conditional probability and use them to interpret data.** Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*	**Builds on and extends ADP:** The treatment given to conditional probability and independent events by the CCSS is much more extensive and specific than ADP.
	CC.9-12.S.CP.6 Use the rules of probability to compute probabilities of compound events in a uniform probability model. Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.*	
	CC.9-12.S.CP.7 Use the rules of probability to compute probabilities of compound events in a uniform probability model. Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.*	
	CC.9-12.S.CP.8 (+) **Use the rules of probability to compute probabilities of compound events in a uniform probability model.** Apply the general	

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	Multiplication Rule in a uniform probability model, P(A and B) = P(A)•P(B|A) =P(B)•P(A|B), and interpret the answer in terms of the model.*	
ADP L4.5. Apply probability concepts to practical situations to make informed decisions.	**CC.9-12.S.CP.2 Understand independence and conditional probability and use them to interpret data.** Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*	**Builds on and extends ADP:** The treatment given to conditional probability and independent events by the CCSS is much more extensive and specific than ADP, including the requirement for students to understand and use expected value.
	CC.9-12.S.CP.3 Understand independence and conditional probability and use them to interpret data. Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.*	
	CC.9-12.S.MD.1 (+) **Calculate expected values and use them to solve problems.** Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.*	
	CC.9-12.S.MD.2 (+) **Calculate expected values and use them to solve problems.** Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. *	
	CC.9-12.S.MD.3 (+) **Calculate expected values and use them to solve problems.** Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*	
	CC.9-12.S.MD.4 (+) **Calculate expected values and use them to solve problems.** Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*	
Mathematical Reasoning: Woven throughout the four domains of mathematics — Number Sense and Numerical Operations; Algebra; Geometry; and Data Interpretation, Statistics and Probability — are the following mathematical reasoning skills:		
ADP MR1. Using inductive and deductive	**CC.K-12.MP.3Construct viable arguments and critique the reasoning of**	**Builds on and extends ADP:**

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reasoning to arrive at valid conclusions.	**others.**Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.	The Mathematical Practices in the CCSS more specifically and completely describe the habits of mind mathematics students should demonstrate.
ADP MR2. Using multiple representations (literal,symbolic, graphic) to represent problems and solutions.	**CC.9-12.F.IF.7 Analyze functions using different representations.** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*	
	CC.9-12.F.IF.8 Analyze functions using different representations. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	
	CC.9-12.F.IF.9 Analyze functions using different representations. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.	
ADP MR3. Understanding the role of definitions, proofs and counterexamples in mathematical reasoning; constructing simple proofs.	**CC.K-12.MP.3** Construct viable arguments and critique the reasoning of others. Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively	

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	about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.	
ADP MR4. Using the special symbols of mathematics correctly and precisely.	**CC.K-12.MP.6** Attend to precision. Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.	
ADP MR5. Recognizing when an estimate or approximation is more appropriate than an exact answer and understanding the limits on precision of approximations.	**CC.K-12.MP.5** Use appropriate tools strategically. Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer algebra system, statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources,	

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	such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.	
ADP MR6. Distinguishing relevant from irrelevant information, identifying missing information and either finding what is needed or making appropriate estimates.	**CC.K-12.MP.5** Use appropriate tools strategically. Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer algebra system, statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.	
ADP MR7. Recognizing and using the process of mathematical modeling: recognizing and clarifying mathematical structures that are embedded in other contexts, formulating a problem in mathematical terms, using mathematical strategies to reach a solution, and interpreting the solution in the context of the original problem.	**CC.K-12.MP.4** Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not	

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	served its purpose.	
	CC.9-12.A.SSE.1 Interpret the structure of expressions. Interpret expressions that represent a quantity in terms of its context.*	
ADP MR8. When solving problems, thinking ahead about strategy, testing ideas with special cases, trying different approaches, checking for errors and reasonableness of solutions as a regular part of routine work, and devising independent ways to verify results.	**CC.K-12.MP.1** Make sense of problems and persevere in solving them. Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.	
ADP MR9. Shifting regularly between the specific and the general, using examples to understand general ideas, and extending specific results to more general cases to gain insight.	**CC.K-12.MP.8 Look for and express regularity in repeated reasoning.** Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.	

Common Core State Standards (CCSS) – Not Aligned with an ADP Benchmark

There are a number of CCSS that are not aligned with an ADP Benchmark. This is the result of the differences in purpose or function of the two documents. The ADP Benchmarks describe the knowledge student should have by the end of high school. The CCSS describe the progression of content through grade 12, and therefore more completely describe the content students should know. This is particularly the case in the areas of modeling, geometry, statistics and probability, and with respect to the conceptual understanding students should have to provide a strong foundation to their work with skills. Furthermore, the CCSS clearly define the content students should know when comparing linear, quadratic, and exponential models. Because the CCSS attempt to clarify progressions of content, even at the high school level, they are more numerous than the ADP Benchmarks and are written at a fine grain size (See Table I: Common Core State Standards (for all students) Not Aligned with an ADP Benchmark). The CCSS also more completely describe the content needed by students who intend to study more advanced mathematics. (See Table II: Common Core State Standards (beyond the core) Not Aligned with an ADP Benchmark). It is not surprising that there are several unmatched CCSS.

Table I: Common Core State Standards (for all students) Not Aligned with an ADP Benchmark
CC.9-12.N.CN.2 Perform arithmetic operations with complex numbers. Use the relation i^2 = –1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
CC.9-12.A.SSE.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)^n as the product of P and a factor not depending on P.*
CC.9-12.A.SSE.3 Write expressions in equivalent forms to solve problems. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
CC.9-12.A.SSE.3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.*
CC.9-12.A.APR.4 Use polynomial identities to solve problems. Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity (x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2 can be used to generate Pythagorean triples.
CC.9-12.A.CED.2 Create equations that describe numbers or relationship. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*
CC.9-12.F.IF.6 Interpret functions that arise in applications in terms of the context. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*
CC.9-12.F.IF.7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.*
CC.9-12.F.BF.3 Build new functions from existing functions. Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects

on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

CC.9-12.F.LE.1a Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.*

CC.9-12.G.CO.13 Make geometric constructions. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

CC.9-12.G.GPE.2 Translate between the geometric description and the equation for a conic section. Derive the equation of a parabola given a focus and directrix.

CC.9-12.G.MG.1 Apply geometric concepts in modeling situations. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

CC.9-12.G.MG.2 Apply geometric concepts in modeling situations. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*

CC.9-12.G.MG.3 Apply geometric concepts in modeling situations. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios). *

CC.9-12.S.CP.1 Understand independence and conditional probability and use them to interpret data. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).*

CC.K-12.MP.7 Look for and make use of structure. Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

Table II: Common Core State Standards (beyond the core) Not Aligned with an ADP Benchmark

CC.9-12.N.CN.3 (+) Perform arithmetic operations with complex numbers. Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

CC.9-12.N.CN.4 (+) Represent complex numbers and their operations on the complex plane. Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.

CC.9-12.N.CN.5 (+) Represent complex numbers and their operations on the complex plane. Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, $(-1 + \sqrt{3}i)^3 = 8$ because $(-1 + \sqrt{3}i)$ has modulus 2 and argument 120°.

CC.9-12.N.CN.6 (+) Represent complex numbers and their operations on the complex plane. Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

CC.9-12.N.CN.8 (+) Use complex numbers in polynomial identities and equations. Extend polynomial identities to the complex numbers. For example, rewrite x^2 + 4 as (x + 2i)(x – 2i).

CC.9-12.N.CN.9 (+) Use complex numbers in polynomial identities and equations. Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

CC.9-12.N.VM.1 (+) Represent and model with vector quantities. Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., **v**, |**v**|, ||**v**||, v).

CC.9-12.N.VM.2 (+) Represent and model with vector quantities. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

CC.9-12.N.VM.3 (+) Represent and model with vector quantities. Solve problems involving velocity and other quantities that can be represented by vectors.

CC.9-12.N.VM.4 (+) Perform operations on vectors. Add and subtract vectors.

CC.9-12.N.VM.4a (+) Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

CC.9-12.N.VM.4b (+) Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

CC.9-12.N.VM.4c (+) Understand vector subtraction **v** – **w** as **v** + (–**w**), where (–**w**) is the additive inverse of **w**, with the same magnitude as **w** and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

CC.9-12.N.VM.5 (+) Perform operations on vectors. Multiply a vector by a scalar.

CC.9-12.N.VM.5a (+) Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(\mathbf{v}_x, \mathbf{v}_y) = (c\mathbf{v}_x, c\mathbf{v}_y)$.

CC.9-12.N.VM.5b (+) Compute the magnitude of a scalar multiple c**v** using ||c**v**|| = |c|**v**. Compute the direction of c**v** knowing that when |c|**v**≠ 0, the direction of c**v** is either along **v** (for c > 0) or against **v** (for c < 0).

CC.9-12.N.VM.6 (+) Perform operations on matrices and use matrices in applications. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

CC.9-12.N.VM.7 (+) Perform operations on matrices and use matrices in applications. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.

CC.9-12.N.VM.8 (+) Perform operations on matrices and use matrices in applications. Add, subtract, and multiply matrices of appropriate dimensions.

CC.9-12.N.VM.9 (+) Perform operations on matrices and use matrices in applications. Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.

CC.9-12.N.VM.10 (+) Perform operations on matrices and use matrices in applications. Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.

CC.9-12.N.VM.11 (+) Perform operations on matrices and use matrices in applications. Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrix as transformations of vectors.

CC.9-12.N.VM.12 (+) Perform operations on matrices and use matrices in applications. Work with 2 X 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.

CC.9-12.S.MD.5 (+) Use probability to evaluate outcomes of decisions. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.*

CC.9-12.S.MD.5a (+) Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*

CC.9-12.S.MD.5b (+) Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low- deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*

CC.9-12.S.MD.6 (+) Use probability to evaluate outcomes of decisions. Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).*

CC.9-12.S.MD.7 (+) Use probability to evaluate outcomes of decisions. Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).*